Vol. 18, No. 3
March 1993

Energy Research Abstracts

Abstracts 4836–7517

Office of Scientific and Technical Information
UNITED STATES DEPARTMENT OF ENERGY

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UNITED STATES DEPARTMENT OF ENERGY
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Vol. 18, No. 3
March 1993
ISSN: 0160-3604
CODEN: ERABDZ

Energy Research Abstracts

Coverage

Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports and patent applications originated by the U.S. Department of Energy, its laboratories, energy centers, and contractors, as well as theses and conference papers and proceedings issued by these organizations in report form. Audiovisual materials, computer media (magnetic tapes, diskettes, etc.), and engineering drawings are included in this definition. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations, *provided* that the full text of the document has been received by OSTI. Foreign report information is obtained through the International Energy Agency's 14-nation Energy Technology Data Exchange, the International Atomic Energy Agency's International Nuclear Information System, or nation-to-nation agreements. The purpose of this publication is to announce documents produced or obtained by DOE that are not so readily available as journal articles, books, or patents.

Scope

The scope of *ERA* encompasses DOE's research, development, demonstration, and technology programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

The citations presented in *ERA* are available for online searching as records within the Energy Science and Technology Database (EDB). The current-year records are available on the Integrated Technical Information System (ITIS).

Availability

DOE and DOE contractors who have OSTI deposit accounts can obtain *ERA* (regular issues and annual indexes) from the Office of Scientific and Technical Information, P.O. Box 62, Oak Ridge, TN 37831, Attention: Information Services. For further information, call (615)576-8401. *ERA* is also available at authorized GPO Depository Libraries. (List is provided on the inside back cover.)

ERA (regular issues and annual indexes) is available to the public on a subscription basis from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Managing Editor, Doris M. Henline
Technical Editor, Milton O. Whitson

Information Sources

The citations presented in *Energy Research Abstracts* are a subset of the worldwide energy information provided to the Office of Scientific and Technical Information (OSTI) through exchange agreements with foreign sources and through exchanges or contracts with U.S. organizations.

The **Energy Technology Data Exchange (ETDE)** was established by the International Energy Agency to promote cooperation among members in conducting appropriate energy-related research and development programs through the development of a formal central information sharing system. In accomplishing the objectives of the ETDE, members select, abstract, and index relevant research information published in their countries in accordance with Exchange standards. OSTI serves as the central receiving and processing center for this information, which it then disseminates to national centers in the participating countries. The following countries are currently members of the ETDE:

- Canada
- Denmark
- Finland
- France
- Federal Republic of Germany
- Italy
- Japan
- The Netherlands
- Norway
- Spain
- Sweden
- Switzerland
- United Kingdom
- United States

The **International Nuclear Information System (INIS)** was established to promote the exchange of information on nuclear science and technology. Its operation is similar to that of the ETDE, with the INIS Secretariat being located in Vienna, Austria. Currently, 79 countries and 15 international organizations are members of INIS. OSTI serves as the INIS national center for the United States.

In the exercise of its rights and responsibilities under the agreements to which it is a party, the **Office of Scientific and Technical Information** both receives information from the above sources and submits U.S.-produced information to them. In addition to materials generated by the Department of Energy, this U.S.-produced information is gathered from other government agencies as well as under contract with private information processing companies. All input is computer processed and entered into a database for online retrieval. The database serves as well for the production of numerous OSTI publications.

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The principal data elements included in these citations are:

1. **Abstract number** within volume.
2. **Report number** identification for report-type literature.
3. **Title and subtitle** (non-English title may appear in parentheses, if applicable).
4. **Author(s).** First 10 names in the data record are printed, then "et al." is listed.
5. **Author affiliation.** Only first one is listed, in parentheses after author(s) to which it applies.
6. **Collaboration,** if present.
7. **Corporate author(s)** identifying corporation responsible for document.
8. **Date of publication.** If not known, a processing date is in brackets.
9. **Number of pages** or page range. Prices are based on total pages unless special pricing applies.
10. **Language** of document if non-English.
11. **Monograph title** if citation is an analytic (part, chapter, or paper) of a larger monograph.
12. **Sponsoring organization.**
13. **Contract or grant number.**
14. **Secondary identifying number;** may be a conference number.
15. **Conference title, location, and date,** if applicable.
16. **Order number.** The "DE" order number may be used for ordering from NTIS or OSTI, as appropriate. The "TI" prefix is valid only at OSTI.
17. **Sources of availability** from which a copy of the document may be obtained; usually appear as abbreviations. (See information on following page.)
18. **Drop note** or explanatory statement.
19. **Abstract.**
20. **Subject descriptors.** Listed only if no abstract or only a brief statement is included.

Sample Citations

Report

18494 (DOE/ER/40438–T1) **[Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report.** Haeberli, W. Phys. VI collaboration. Wisconsin Univ., Madison (USA). Dept. of Physics. [1989]. 12p. Sponsored by DOE Energy Research. DOE Contract FG02-88ER40438. Order Number DE89007246. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper briefly discusses the Wisconsin test facility for storage cells; results of target tests; the new UHV...

Report Analytic

18500 (INIS-SU—69, pp. 30-32) **Transition energies in Ne-like ions. Correlation effects.** Vainshtejn, L.A. AN SSSR, Moscow. Fizicheskij Inst. 1988. (In Russian). In *Experimental and theoretical physics. Collection.* Order Number DE89780060. Available from NTIS (US Sales Only), PC A03/MF A01; INIS.

Kratkie Soobshcheniya po Fizike.; no. 6.

SILVER IONS/energy-level transitions; XENON IONS/energy-level transitions; CORRELATIONS; D STATES; E STATES;...

54 (DOE/ER/60888-1-Vol.1, pp. 115-117) **Investigation of air pollution in house due to use of various fuels.** Luo, Dayu (Chengdu Sanitation (China)). Canada Mortgage and Housing Corp., Ottawa, ON (Canada). 1990. (CONF-900724-Vol.1: Indoor Air '90: 5th international conference on indoor air quality and climate, Toronto (Canada), 29 Jul - 3 aug 1990). In Indoor air '90: The fifth international conference on indoor air quality and climate. Volume 1: Final report. 786p. Order Number DE90017786. Source: NTIS.

Air pollution in houses caused by combustion of coal is more serious than that by combustion of natural gas and methane (primarily by SO_2 and NO_2). The gas concentration after cooking is higher than that before cooking, and it is higher in kitchen than in bedroom and outdoor. There were mutations in the extract from TSP in $30m^2$ air in the bedroom, kitchen and outdoor, where coal and natural gas were used. The supernatant saliva activity of children whose family uses coal is significantly lower than that of pumping streams.

How To Order from the Availability Sources

TO OBTAIN A REPORT

Report literature, usually identified by an alphanumeric identifier at the beginning of a citation, is available from the sources listed in the citation (see example of element 2 on page iii). Often the sources are listed as abbreviations. Corresponding addresses are provided at right from which documents with these abbreviations may be ordered. When "OSTI" is given, **DOE and DOE contractors may order these documents from OSTI.** (However, check with your library or information organization which may require that orders go through them to OSTI.) OSTI prices are based on total pages unless special pricing applies. The public should order from NTIS or from one of the other agencies listed in the citation. NTIS price codes may continue to appear in some records. To expedite processing, an order form is provided in the back of this publication. NOTE: The order numbers provide quicker access for report ordering. Use the order number where possible.

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Government Printing Office
Washington, DC 20402

GPO Dep. Available for inspection or interlibrary loan at Government Printing Office regional depository libraries.

INIS *Available only in microfiche.*
INIS Clearinghouse
International Atomic Energy Agency
P.O. Box 100, A-1400
Vienna, Austria

NTIS U.S. Department of Commerce
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161

OSTI U.S. Department of Energy
Office of Scientific and Technical Information
P.O. Box 62
Oak Ridge, TN 37831

ESTSC Energy Science and Technology Software Center
P.O. Box 1020
Oak Ridge, TN 37831

How To Use the Indexes

Five indexes are provided for approaching the content of each issue of *Energy Research Abstracts*. Descriptions of entries in these indexes follow.

Corporate Author Index
The corporation, organization, or institution responsible for the issuance of the document is listed in this index. The entries are arranged alphabetically and provide the title and citation number of the reference. For example, the listing for the "Report" sample citation would appear as shown at right.

Wisconsin Univ., Madison (USA). Dept. of Physics
[Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report, 15:18494 (R;US)
Wisconsin Univ., Madison (USA). Lab. of Genetics
Organization of the R chromosome region in maize: Final progress report, June 1, 1983–May 31, 1986, 15:18255 (R;US)

Personal Author Index
Each author's name listed on a document cited in this issue is indexed. An index entry provides title and citation number; for secondary and other names, a cross-reference is given to the primary author name where the full index entry is located.

Hadley, D.L., *See* Lee, A.D., 15:17651
Haeberli, W., [Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report, 15:18494 (R;US)

Subject Index
This index lists the main subject descriptors assigned to each record by indexing professionals. A secondary or qualifier term is used where necessary to describe materials, objects, and processes. Document titles may be enhanced with additional informative phrases where necessary. An excerpt from this index appears at right.

HYDROGEN ISOTOPES
See also DEUTERIUM
HYDROGEN 4
TRITIUM
Neutron-Rich Isotopes
Study on the strong neutron-rich nuclei of lightest elements, 15:18686 (RA;SU;In Russian)

Contract Number Index
DOE technical reports are listed by contract number. Each entry also provides the primary corporation or organization cited for that contract number. A typical entry is shown.

FG02-88ER40438 **Wisconsin Univ., Madison (USA). Dept. of Physics**
15:18494 DOE/ER/40438–T1
FG02-88ER60664 **Rogers and Associates Engineering Corp., Salt Lake City, UT (USA)**

Report Number Index
Technical report literature is indexed by the alphanumerical identifier of the report. Patent documents and conferences are included for convenience. Each entry lists the citation number, the source of availability of the document, an indicator of presence at a GPO depository library, order number, and distribution category. A typical entry is:

DOE/ER/40438–T1	15:18494	NTIS, OSTI	E 1.99: DE89007246	MF-411

Subject Contents

The subject content of *Energy Research Abstracts* is arranged as shown below. The two-digit and four-digit category numbers printed here illustrate the category number assignment used in the database records.* The following list includes all of the 38 first-level and the 313 second-level categories. Because each issue of *ERA* publishes citations only for those documents announced during the past semimonthly period, some subject categories may not be present in every issue.

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*The numerical subject category scheme is used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's data systems. Categories and definitions for the complete set of six-digit numbers are given in ETDE/PUB--1-R2, *International Energy: Subject Categories and Scope*.

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Energy Research Abstracts

01 COAL, LIGNITE, AND PEAT

4836 (CONF-920979–) **US Department of Energy first annual clean coal technology conference: Proceedings.** USDOE, Washington, DC (United States). Nov 1992. 971p. Sponsored by USDOE, Washington, DC (United States). From 1. annual clean coal technology conference; Cleveland, OH (United States); 22-24 Sep 1992. Order Number DE93004314. Source: OSTI; NTIS; INIS; GPO Dep.

The first public review of the US DOE/Industry co-funded program to demonstrate the commercial readiness of Clean Coal Technologies (CCT) was held at Cleveland, Ohio Sept. 22–24, 1992. The objectives were to provide electric utilities, independent power producers, and potential foreign users information on the DOE-supported CCT projects including status, results, and technology performance potential; to further understanding of the institutional, financial, and technical considerations in applying CCTs to Clean Air Act compliance strategies; to discuss to export market, financial and institutional assistance, and the roles of government and industry in pursuing exports of CCTs; and to facilitate meetings between domestic and international attendees to maximize export opportunities.

0103 Preparation

Refer also to citation(s) 4918, 4920

4837 (DOE/PC/90258–T1-Vol.1) **Characterization and supply of coal based fuels: Volume 1, Final report and appendix A (Topical report).** Energy International Corp., Pittsburgh, PA (United States). Jun 1992. 172p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-86PC90258. Order Number DE93005136. Source: OSTI; NTIS; GPO Dep.

Studies and data applicable for fuel markets and coal resource assessments were reviewed and evaluated to provide both guidelines and specifications for premium quality coal-based fuels. The fuels supplied under this contract were provided for testing of advanced combustors being developed under Pittsburgh Energy Technology Center (PETC) sponsorship for use in the residential, commercial and light industrial (RCLI) market sectors. The requirements of the combustor development contractors were surveyed and periodically updated to satisfy the evolving needs based on design and test experience. Available coals were screened and candidate coals were selected for further detailed characterization and preparation for delivery. A team of participants was assembled to provide fuels in both coal-water fuel (CWF) and dry ultrafine coal (DUC) forms. Information about major US coal fields was correlated with market needs analysis. Coal fields with major reserves of low sulfur coal that could be potentially amenable to premium coal-based fuels specifications were identified. The fuels requirements were focused in terms of market, equipment and resource constraints. With this basis, the coals selected for developmental testing satisfy the most stringent fuel requirements and utilize available current deep-cleaning capabilities.

4838 (DOE/PC/90258–T1-Vol.2) **Characterization and supply of coal based fuels: Volume 2, Appendicies B through M, Final report.** Energy International Corp., Pittsburgh, PA (United States). Jun 1992. 296p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-86PC90258. Order Number DE93005137. Source: OSTI; NTIS; GPO Dep.

This report discusses a number of special fuel slurries with a short description of the preparation method and numerous data sheets.

4839 (DOE/PC/90295–T8) **Pyrite surface characterization and control for advanced fine coal desulfurization technologies: Eighth quarterly technical progress report, June 1, 1992–August 31, 1992.** Wang, X.H.; Leonard, J.W.; Parekh, B.K.; Raichur, A.M.; Jiang, C.L. Kentucky Univ., Lexington, KY (United States). [1992]. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-90PC90295. Order Number DE93004946. Source: OSTI; NTIS; GPO Dep.

The objective of the project is to conduct extensive fundamental studies on the surface reactivity and surface hydrophobicity of coal-pyrites using various surface characterization techniques and to understand how the alteration of the coal-pyrite surface affects the efficiency of pyrite rejection in coal flotation. During this reporting period, the influence of the impurity content, particularly coal/carbon content, on the electrochemical oxidation of pyrite surfaces was investigated. The studies demonstrate that the coal/carbon content in coal-pyrite has a determining effect on the surface reactivity of pyrite. The oxidation behavior of high carbon-content coal-pyrite is completely different from that of purer coal-pyrite and ore-pyrite. The effects of flotation gases on the flotation behavior of coal and the surface hydrophobicity of various coal-pyrite were investigated. It was found from the lab-scale column flotation studies that among the various gases studied (air, oxygen, argon, nitrogen and carbon dioxide), carbon dioxide produced the best results with a combustible recovery of 90% and ash-content of less than 9 percent. Finally, the surface energetic studies revealed that the surfaces of pyrites and coals produced by wet grinding is more heterogenous than that prepared by dry grinding.

4840 (DOE/PC/91280–T5) **Coal-sand attrition system and its' importance in fine coal cleaning: Quarterly report, May 31, 1991–August 31, 1992.** Mehta, R.K.; Schultz, C.W. Alabama Univ., University, AL (United States). Mineral Resources Inst. [1992]. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-91PC91280. Order Number DE93004929. Source: OSTI; NTIS; GPO Dep.

The primary objective of this project is geared toward the substitution of steel media by fracturing silica sand as a grinding media for ultraline coal grinding. The project has been divided into four subgroups for bookkeeping purposes and possible ease of execution. Some of the tasks would be executed simultaneously as overlapping is inevitable. The grouping is as follows: (1) sample procurement, preparation, and characterization; (2) batch grinding tests; (3) continuous grinding tests; and, (4) fracture mechanics. The hardgrove indices for the four coals employed in this work have finally been determined by the personnel at the R and D Center of Drummond Coal Company using 14 x 28 mesh feed size materials. The values obtained for the respective coals are given in Table 1.

4841 (VTT-OPT–45, pp. 35-36) **Increment of sod peat yield by improving the drying base and by load optimation.** Erkkilae, A. (Technical Research Centre of Finland, Jyvaeskylae (Finland). Combustion and Thermal Engineering Laboratory). Technical Research Centre of Finland, Jyvaeskylae (Finland). Combustion and Thermal Engineering Lab. 1992. (In Finnish). Project KTM-275/881/87. In *Research results of the Optimiturve research program in 1991.* 69p. Order Number DE93752849. Source: OSTI; NTIS.

OPTIMITURVE Research Programme.

The aim of this study has been to seek possibilities for increment of field load to respond the theoretical optimum, and hence to increase the hectare yield of sod peat production. The study consists of development of the drying field so that it better leads the rain water off the surface of the field and minimization of the water rising from the surface into the sod. One layer adjusting demands new methods for adjusting of the sod and improving of the surface quality to the level demanded by the upright position of the sod. The laboratory experiments have been made using cylindrical sod placed in upright position in weather and field condition simulator. The initial moisture content of the peat mass, maceration time, the length of the sod, the longitudinal and transversal distance of the sod, and the quality of the drying base were used as variables in the tests. The position of the sod on the field had to be taken as

an additional variable during the tests, because it also effected on drying results. The tests were designed with the aid of multi-variant method. The number of tests was 16. The tests were made using four weather cupboard runs, four tests in each run. The drying time, weight and dimensions of the sod were measured during the tests. According to the preliminary test results, the length and longitudinal distance of the sod had great effect on drying, and the maceration of the peat mass seems to have a minimum in the drying time.

4842 (VTT-OPT–46) **Utilization of aerial photography in peat production.** Tervo, M. Technical Research Centre of Finland, Jyvaeskylae (Finland). Combustion and Thermal Engineering Lab. 1992. 50p. (In Finnish). Project KTM-275/881/87. Order Number DE93752940. Source: OSTI; NTIS.

OPTIMITURVE Research Programme.

The technical and economical applicability of different aerial photographic methods for intensification of peat production and production control have been studied in this research. According to the research results, obtained in the aerial photography and ground measurements carried out during the summer 1991, the photographic methods (both panchromatic and near infra-red) are suitable for coarse determination of quality variation of surface peat. Especially, the light poorly humified surfaces are readily observable from the aerial photographs. Additionally, the photographic methods can be used for control of the condition of ditching on production mires, for environmental monitoring, and for determination of the dimensions of the production area and stockpiles (the strip length, the surface area, the volume of the stockpile, the surface levelling, etc.) Especially, the large scale determination of stockpile volumes using aerial photographs seems to be suitable for development. According to the photography in the summer 1991, it is possible to detect areas of different moisture content using thermal photography, so it might be suitable for determination of the basic drainage level of a production field. However, more research is needed for determination of the accuracy of the method. Thermal photography has been widely used for control of self heating of the peat stockpiles during several autumns.

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Refer also to citation(s) 4900, 4904, 4932, 5022, 5230, 5231, 5339, 5340, 5341, 5411, 5768, 5829, 5830, 6138

4843 (CONF-9210165–2) **Examination of Japanese samples exposed in the Wilsonville liquefaction reactors.** Keiser, J.R.; Henson, T.J. Oak Ridge National Lab., TN (United States). 1992. 50p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 9. AIST-NEDO/DOE-PETC joint technical meeting on coal liquifation; San Francisco, CA (United States); 12-15 Oct 1992. Order Number DE93002339. Source: OSTI; NTIS; GPO Dep.

Fourteen samples provided by Mitsui SRC Development Co., Ltd. were exposed for 2497 hours through nozzles near the top of the two liquefaction reactors at the Wilsonville, Alabama, coal liquefaction facility. The samples were exposed during the entirety of run 263 which was the final run conducted at this facility. Examination of the samples provided the following information. (1) Both sets of samples with aluminum coatings had significantly greater weight losses than any of the other samples. The hot-dipped aluminum coating spalled in many areas leaving a layer rich in aluminum and iron. (2) The alumina plasma sprayed sample had an inner chromium-nickel layer, and there was a significant accumulation of metal sulfides between this inner layer and the base metal. (3) The titanium nitride CVD coated sample had an adherent, continuous coating and a very low corrosion rate. Chlorine, likely a result of the CVD process, was present in the coating. (4) The three uncoated metals, 2.25 Cr-1 Mo, 9 Cr-1 Mo, and the material labeled as 321 stainless steel, had low calculated corrosion rates and showed no evidence of corrosion in the microscopic or microprobe examinations.

4844 (DOE/ER/13580–T2) **Mechanisms and controlling characteristics of the catalytic oxidation of methane: Technical progress report, June 15, 1990–December 14, 1992.** Klier, K.; Simmons, G.W.; Herman, R.G.; Miller, A.C. Lehigh Univ., Bethlehem, PA (United States). [1992]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-86ER13580. Order Number DE93005719. Source: OSTI; NTIS; GPO Dep.

We have demonstrated in this work (1) that methane is readily activated at mild conditions (100°C, 1 torr) over a relatively noble metal, Pd. This was observed using a stepped and kinked Pd(679) crystal (1), and other crystal faces are now being investigated to establish whether the cracking of the C-H bond of methane on Pd is structure sensitive or structure insensitive. Oxygen chemisorption is extremely structure sensitive: weakly bonded, highly reactive oxygen overlayers form on Pd(100) surface (2), while strongly bonded, moderately reactive oxygen overlayers form on Pd(111) and Pd(679). Reaction of the weakly bonded oxygen with surface carbide gives rise to CO_2 over clean Pd(100) but to CO over halogen-doped Pd(100) (3–5). The effect of halogens is primarily ensemble-controlling, or oxygen-supply restricting, but long range influence of surface Cl on the strength of the Pd-O bond has also been observed (3). Because the overall chemistry of methane activation with the subsequent oxidation gives rise to the very important oxidative reforming $CH_4 + 1/2\ O_2 \rightarrow_{Pd/Cl} CO + 2\ H_2$, Pd/Cl we plan to continue our study of this reaction in detail over Pd(100) (completed), Pd(111) (initiated), Pd(311) (initiated), Pd(110) (to be initiated), and Pd(679) (completed), without and with the halogen modifiers.

4845 (DOE/ER/80591–93/C0126) **Low-cost ceramic membranes and supports for gas separation.** Goldsmith, R.L.; Higgins, R.J.; Bishop, B.A. CeraMem Corp., Waltham, MA (United States). [1992]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-88ER80591. (CONF-920951–43: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93003208. Source: OSTI; NTIS; GPO Dep.

The objectives of this program are to: 1. Develop a passive, highly selective, molecular sieve membrane capable of purifying coal process conversion gases at temperatures over 600°C. 2. Fabricate and determine the performance characteristics of such a membrane based on a practical (i.e., low cost, high surface area) support module. In the first year of the program a number of membrane compositions and processing techniques were evaluated with the objective of producing gas separation membranes with subnanometer pore diameter. This work involved use of 25 mm diameter alumina ultrafiltration disks as membrane supports and investigated membrane coatings of refractory oxides, including alumina, zirconia, ceria, and silica. During this first year, a preferred membrane composition and processing conditions were identified that allowed fabrication of disk-supported membranes with submanometer size pores. Continuing work in this area during the second year of the program involved optimization of the fabrication of these gas separation membranes and determination of their gas permeability properties at temperatures up to 200°C. Disk-supported membranes were fabricated that exhibited molecular sieving behavior and He/N_2 selectivities in excess of 50 at 200°C. Two other elements of this project were initiated during the first two years of this program and are the focus of current experimental work. One of these elements involves application of gas separation membranes to commercially obtained ceramic tubular ultrafiltration (UF) membranes. The second element involves continued investigations related to application of gas separation membranes to low-cost, high-surface-area ceramic ultrafiltration modules based on honeycomb monolith supports (manufactured by CeraMem Corporation). This paper relates current findings in these areas of investigation.

4846 (DOE/ER/80877–93/C0116) **Mild gasification in transport reactors.** Solomon, P.R.; Bates, S.C.; Zhao, Y. Advanced Fuel Research, Inc., East Hartford, CT (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-90ER80877. (CONF-920951–28: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93002603. Source: OSTI; NTIS; GPO Dep.

Forty-five runs were made varying coal type (lignites, subbituminous, and bituminous), temperature (550, 600, 650 and 700°C), pressure (1 atmosphere to 80 psig), pyrolyzing gas (nitrogen or steam), and residence time (2.5 sec to 15 sec). Some typical results are summarized in Table 2 which presents the pyrolysis product distribution between char, tar, gas, water, and missing as well as the gas composition. Percent tar yield quantities are based on a Dry Ash Free (DAF) weight percent of total coal fed into the reactor. The component designated missing is a combination of collection variations and light tar molecules which evaporate during the collection process. Some very light tars (paraffins and olefins in the gas analysis) are analyzed and included with the gases sampled in the FTIR cell. The tar yields shown in this report, which range from 5% for lignite at high pressure to 30% for bituminous coals at one atmosphere, represent a minimum value; the actual tar yield should be the missing plus those tars included in the gas analysis. The TG-FTIR summary of tars evolved, Table 1, may give a better indication of the total tar yield. However, the TG-FTIR does not pyrolyze coal under the same conditions as the HTR. As shown in Figs. 4–6 and Table 2, pyrolysis tar yields for all coals have an optimum temperature of approximately 600°C using a 2.5 sec resident time. The yields decrease with increases in pressure. Lower heating rates and longer residence times usually lead to lower tar yields. The degree to which tar yields decrease depends on the amount of pressure and the reaction temperature. There were no significant differences in tar yield when nitrogen or steam was used as the carrier gas.

4847 (DOE/ER/80896–93/C0097) **Ceramic filters for removal of particulates from hot gas streams.** Goldsmith, R.L. CeraMem Corp., Waltham, MA (United States). [1992]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER80896. (CONF-920951–17: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93002709. Source: OSTI; NTIS; GPO Dep.

The primary goal is to demonstrate the performance of a new ceramic filter in removing particulate matter from hot gas streams produced in advanced coal conversion processes. The specific objectives are threefold: (1) Development of full size ceramic filters suitable for hot gas filtration; (2) Demonstration of ceramic filters in long term (ca. 1000 hrs) field trials; and (3) Development of full-scale hot gas filter system designs and costs. To date, field tests of the ceramic filter for particulate removal have been conducted at seven sites on a variety of gas streams and under a variety of test conditions. In general, the following performance characteristics have been observed: 1. Filtration face velocity (equivalent to an "air to cloth ratio") for flue gas tests is comparable to that for pulse jet bags operating at the same pressure drop. In hot gas tests, flow-pressure drop characteristics have been observed to be comparable to those for other ceramic filters. 2. Complete regeneration by a simple backpulse technique is achieved; i.e., no increase in clean filter resistance over repetitive cycles is observed. 3. No plugging of the filter passageways by badly caking particulates is observed. 4. Essentially complete particulate removal, including submicron particulate matter, is achieved.

4848 (DOE/ER/80998–93/C0128) **High temperature hydrogen sulfide removal.** Copeland, R.J.; Karpuk, M.E. TDA Research, Inc., Wheat Ridge, CO (United States). [1992]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-90ER80998. (CONF-920951–42: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93003207. Source: OSTI; NTIS; GPO Dep.

The objective is to develop and test a regenerable stannic oxide-based sorbent to remove H_2S from hot coal gases while producing sulfur as the only product. The detailed technical objectives in support of this are: (1) Develop mechanically strong and chemically inert support materials which will retain their properties through multiple absorption regeneration cycles. (2) Develop mathematical models to predict the performance of large-scale systems from benchscale results. (3) Test the durability of the best sorbent/support combinations. (4) Conduct a bench-scale proof of concept test with the best stannic-oxide sorbent. Several approaches are being used to develop long-life sorbents. The investigators have tested sorbents produced by agglomeration, pressing, and extrusion. To date over 50 formulations have been tested, with several showing promise. Table II presents the results on five of these formulations; all of these formulations had surface areas in excess of 2 m^2/gm. All of the formulations meet the goals for porosity, tin content, and surface area. The crush strength for a 1/8inches dia. by 1/8inches long sorbent is significantly affected by the method of preparing the sorbent.

4849 (DOE/ER/81228–93/C0100) **High-temperature membranes for gas separation and gas cleanup.** Edlund, D.J. Bend Research, Inc., OR (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-91ER81228 ;FG03-91ER81229. (DOE/ER/81229–93/C0100;CONF-920951–45: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93002731. Source: OSTI; NTIS; GPO Dep.

Research is directed at furthering the development of two metal-membrane-based processes for (1) economically producing pure hydrogen from the raw gasifier stream, and (2) cleanly and efficiently removing hydrogen sulfide from the hot gas stream. Both of these processes would be accomplished at 700°C to 800°C and are based on a novel hydrogen-permeable composite-metal membrane. Initial results from lifetime tests of the composite-metal membrane have been started. Figure 5 shows flux vs. time for a composite-metal membrane that was operated between 700°C and 540°C with a 100-psig hydrogen feed. This test was stopped after about 13 days when the gasket used to seal the membrane to the permeation cell failed. Two additional furnaces have been built for testing laboratory-scale membrane reactors and conducting lifetime tests. Construction of a vacuum brazing furnace has been completed. We have started evaluations of two promising joining methods-metal gaskets and brazed joints-for fabricating preprototype membrane modules.

4850 (DOE/MC–93/C0118) **H_2S-removal and sulfur-recovery processes using metal salts.** Lynn, S.; Cairns, E.J. Lawrence Berkeley Lab., CA (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (DOE/NBM–93000208;CONF-920951–27: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93000208. Source: OSTI; NTIS; GPO Dep.

Scrubbing a sour gas stream with a solution of copper sulfate allows the clean-up temperature to be increased from ambient to the adiabatic saturation temperature of the gas. The copper ion in solution reacts with the H_2S to produce insoluble CuS. The choice of copper sulfate was set by the very low solubility of CuS and the very rapid kinetics of the Cus formation. Since the copper sulfate solutions used are acidic, CO_2 will not be co-absorbed. In a subsequent step the solid CuS is oxidized by a solution of ferric sulfate. The copper sulfate is regenerated, and elemental sulfur is formed together with ferrous sulfate. The ferrous sulfate is reoxidized to ferric sulfate using air. Since the copper sulfate and ferric solutions are regenerated, the overall reaction in this process is the oxidation of hydrogen sulfide with oxygen to form sulfur. The use of copper sulfate has the further advantage that the presence of sulfuric acid, even as concentrated as 1 molar, does not inhibit the sorption of H_2S. Furthermore, the absorption reaction remains quite favorable thermodynamically over the temperature range of interest. Because the reaction goes to completion, only a single theoretical stage is required for complete H_2S removal and cocurrent gas/liquid contacting may be employed. The formation of solids precludes the use of a packed column for the contacting device. However, a venturi scrubber would be expected to perform satisfactorily. The kinetics of the oxidation of metal sulfides, in particular zinc and copper sulfide, is reported in the literature to be slow at near-ambient temperatures. The proposed process conditions for the oxidation step are different from those reported in the literature, most notably the higher temperature. The kinetics of the reaction must be studied at high temperatures and corresponding pressures. An important goal is to obtain sulfur of high purity, which is a salable product.

4851 (DOE/MC/10637–93/C0121) **Coal ash behavior in reducing environments.** Erickson, T.A.; Benson, S.A.; Steadman, E.N.; Brekke, D.W.; Folkedahl, B.C.; Tibbetts, J.E.; Nowok, J. North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center. [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC21-86MC10637. (CONF-920951–54: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93004094. Source: OSTI; NTIS; GPO Dep.

A key factor in the successful design and operation of coal gasification systems is the ability to control and mitigate ash-related problems. Some of the major ash-related problems are slag flow control, slag attack on the refractory, ash deposition on heat-transfer surfaces, corrosion and erosion of equipment materials, and emissions control. Such problems are closely tied to the abundance and association of the inorganic components in coal and the gasification conditions. The CABRE project is a three-year program designed to investigate the transformations and properties of coal ash in reducing environment systems. The CABRE project is organized into a three-task structure which is the backbone of the project's strength. Task 1, Analytical Methods Development, has concentrated on the special needs of analyzing samples produced under a reducing atmosphere as opposed to the more often studied combustion systems. Task 2, Inorganic Partitioning and Ash Deposition, has focused on the production of gasification-type samples under closely controlled conditions for the study of inorganic partitioning that may lead to deposition. Task 3, Ash and Slag Physical Properties, has made large gains in the areas of sintering and strength development of coal ashes under reducing atmospheres for the evaluation of deposition problems.

4852 (DOE/MC/23075–93/C0106) **Measurements and modeling of advanced coal conversion processes.** Solomon, P.R.; Smoot, L.D.; Serio, M.A.; Hamblen, D.G.; Brewster, B.S. Advanced Fuel Research, Inc., East Hartford, CT (United States). [1992]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-86MC23075. (CONF-920951–37: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93003202. Source: OSTI; NTIS; GPO Dep.

To expand the utilization of coat it is necessary to reduce the technical and economic risks inherent in utilizing a feedstock which is highly variable and which sometimes exhibits unexpected and unwanted behavior. Reducing the risks can be achieved by establishing the technology to predict a coal's behavior in a process. This program is creating this predictive capability by merging technology developed at Advanced Fuel Research, Inc. (AFR) in predicting coal conversion behavior, and technology developed at Brigham Young University (BYU) in comprehensive computer codes for modeling of entrained-bed gasification. Additional capabilities in predicting pollutant formation will be implemented and the technology will be expanded to fixed-bed reactors. The foundation to describe coal-specific conversion behavior is AFR's Functional Group (FG) and Depolymerization, Vaporization, and Crosslinking (DVC) models. The FG-DVC model is being improved and integrated with BYU's comprehensive two-dimensional reactor model, PCGC-2 and with a new one-dimensional advanced fixed-bed code. The program consists of four tasks: (1) Preparation of Research Plans, (2) Submodel Development and Evaluation, (3) Comprehensive Model Development and Evaluation, and (4) Applications and Implementation. This paper covers work during the past year in Tasks 2, 3, and 4.

4853 (DOE/MC/23075–3149) **Measurement and modeling of advanced coal conversion processes: Twenty-second quarterly report, January 2, 1992–March 31, 1992.** Solomon, P.R. (Advanced Fuel Research, Inc., East Hartford, CT (United States)); Serio, M.A.; Hamblen, D.G.; Smoot, L.D.; Brewster, B.S. Advanced Fuel Research, Inc., East Hartford, CT (United States); Brigham Young Univ., Provo, UT (United States). [1992]. 116p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-86MC23075. Order Number DE93004061. Source: OSTI; NTIS; GPO Dep.

The objectives of this proposed study are to establish the mechanisms and rates of basic steps in coal conversion processes, to integrate and incorporate this information into comprehensive computer models for coal conversion processes, to evaluate these models and to apply them to gasification, mild gasification and combustion in heat engines. This report describes progress during twenty second quarter of the program. Specifically, the paper discusses progress in three task areas: (1) Submodel development and evaluation: coal to char chemistry submodel; fundamental high-pressure reaction rate data; secondary reaction of pyrolysis product and burnout submodels; ash physics and chemistry submodel; large particle submodels; large char particle oxidation at high pressures; and SO_x-NO_x submodel development and evaluation; (2) Comprehensive model development and evaluation: integration of advanced submodels into entrained-flow code, with evaluation and documentation; comprehensive fixed-bed modeling review, development evaluation and implementation; and generalized fuels feedstock submodel; and (3) Application of integrated codes: application of generalized pulverized coal comprehensive code and application of fixed-bed code.

4854 (DOE/MC/23075–3151) **Measurement and modeling of advanced coal conversion processes: 23rd quarterly report, April 1, 1992–June 30, 1992.** Solomon, P.R. (Advanced Fuel Research, Inc., East Hartford, CT (United States)); Serio, M.A.; Hamblen, D.G.; Smoot, L.D.; Brewster, B.S. Advanced Fuel Research, Inc., East Hartford, CT (United States); Brigham Young Univ., Provo, UT (United States). [1992]. 84p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-86MC23075. Order Number DE93004068. Source: OSTI; NTIS; GPO Dep.

The overall objective of this program is the development of predictive capability for the design, scale up, simulation, control and feedstock evaluation in advanced coal conversion devices. This technology is important to reduce the technical and economic risks inherent in utilizing coal, a feedstock whose variable and often unexpected behavior presents a significant challenge. This program will merge significant advances made at Advanced Fuel Research, Inc. (AFR) in measuring and quantitatively describing the mechanisms in coal conversion behavior, with technology being developed at Brigham Young University (BYU) in comprehensive computer codes for mechanistic modeling of entrained-bed gasification. Additional capabilities in predicting pollutant formation will be implemented and the technology will be expanded to fixed-bed reactors. The foundation to describe coal-specific conversion behavior is AFR's Functional Group (FG) and Devolatilization, Vaporization and Crosslinking (DVC) models, developed under previous and on-going METC sponsored programs. These models have demonstrated the capability to describe the time dependent evolution of individual gas species, and the amount and characteristics of tar and char. The combined FG-DVC model will be integrated with BYU's comprehensive two-dimensional reactor model, PCGC-2, which is currently the most widely used reactor simulation for combustion or gasification. The program includes: (i) validation of the submodels by comparison with laboratory data obtained in this program, (ii) extensive validation of the modified comprehensive code by comparison of predicted results with data from bench-scale and process scale investigations of gasification, mild gasification and combustion of coal or coal-derived products in heat engines, and (iii) development of well documented user friendly software applicable to a "workstation" environment.

4855 (DOE/MC/23277–93/C0087) **Integration and testing of hot desulfurization and entrained flow gasification for power generation systems.** Leininger, T.F.; Robin, A.; Jung, D.Y.; Kassman, J.S.; Wolfenbarger, J.K.; Yang, P.P. Texaco, Inc., Montebello, CA (United States). Montebello Research Lab. [1992]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC21-87MC23277. (CONF-920951–18: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93002614. Source: OSTI; NTIS; GPO Dep.

To help achieve the goal of clean, low cost power generation from coal, Texaco submitted an unsolicited proposal in July 1986 to

develop and demonstrate the integration of high temperature desulfurization with the Texaco Coal Gasification Process (TCGP). The main goals of the proposed program were: Develop and demonstrate in-situ desulfurization of synthesis gas in an entrained flow gasifier using both air and oxygen gasification. Develop and demonstrate a high efficiency integrated system on a process development unit (PDU) scale which would include coal preparation, gasification, sulfur removal, particle and trace element removal and a gas turbine. In addition, secondary goals were proposed which would help further major research in which DOE/METC was already involved. These were: Test advanced instruments developed by METC for coal conversion processes. Screen alternative high temperature sulfur removal sorbents that could be used external to the gasifier. Development of these sorbents would provide a backup to the in-situ desulfurization approach. Accomplishments to date are presented.

4856 (DOE/MC/24116–93/C0109) **Development of an advanced, continuous mild gasification process for the production of co-products.** Wolfe, R.A.; Wright, R.E.; Im, C.J.; Henkelman, M.R.; O'Neal, G.W. Coal Technology Corp., Bristol, VA (United States). [1992]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-87MC24116. (CONF-920951–13: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93002746. Source: OSTI; NTIS; GPO Dep.

The objective of this project is to develop a continuous mild gasification process to convert highly caking coals to coal liquids, char and coke for near term commercial application. Task 3, Bench-Scale Char Upgrading Study, has been underway since September 1989. In char upgrading studies, "green" uncured char briquettes have been prepared and calcined in 20-pound batches to evaluate the effects of char, binders, and heating conditions on final coke properties. A total of 150. formulations have been tested thus far in this work. Work on Task 4, Process Development Unit (PDU) Mild Gasification Study, has been in progress since February 1991, with the completion of a Continuous Mild Gasification Unit (CMGU) with a design rate of 1000 lb./hr. Since start-up of the CMGU, there have been 72 runs with a variety of operating conditions and coal types.

4857 (DOE/MC/24138–93/C0088) **Calderon coal gasification Process Development Unit design and test program.** Calderon, A.; Madison, E.; Probert, P. Calderon Energy Co., Bowling Green, OH (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG21-87MC24138. (CONF-920951–36: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93003201. Source: OSTI; NTIS; GPO Dep.

The Process Development Unit (PDU) was designed and constructed to demonstrate the novel Calderon gasification/hot gas cleanup process. in the process, run-of-mine high sulfur coal is first pyrolyzed to recover a rich gas (medium Btu gas), after which the resulting char is subjected to airblown gasification to yield a lean gas (low Btu gas). The process incorporates a proprietary integrated system for the conversion of coal to gases and for the hot cleanup of the gases which removes both particulate and sulfur components of the gaseous products. The yields are: a syngas (CO and H_2 mix) suitable for further conversion to liquid fuel (e.g. methanol/gasoline), and a lean gas suitable to fuel the combustion turbine of a combined cycle power generation plant with very low levels of NO_x (15 ppmv). The fused slag (from the gasified char ash content) and the sulfur recovered during the hot gas cleanup will be sold as by-products. The small quantity of spent sorbent generated will be combined with the coal feed as a fluxing agent for the slag. The small quantity of wastewater from slag drainings and steam generation blowdown will be mixed with the coal feed for disposal. The Calderon gasification/hot gas cleanup, which is a completely closed system, operates at a pressure suitable for combined cycle power generation.

4858 (DOE/MC/25003–93/C0090) **Enhanced durability of high-temperature desulfurization sorbents for moving-bed applications.** Ayala, R.E.; Gal, E.; Gupta, R.P. General Electric Co., Schenectady, NY (United States). Corporate Research and Development Center. [1992]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-88MC25003. (CONF-920951–29: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93002612. Source: OSTI; NTIS; GPO Dep.

Chemical reactivity was determined at GECRD by measuring sorbent sulfur loading (defined as grams of sulfur absorbed per 100 g of fresh sorbent) in fresh and in cycled samples from a bench-scale reactor. Only formulations that exhibited a good balance of chemical and mechanical performance as fresh pellets were selected for further cyclic testing in the benchscale reactor system. Details of the bench-scale reactor and procedures have been given before (Ayala, 1991). The important aspect of the benchscale testing is that both absorption and regeneration were conducted in a packed-bed reactor simulating the time/temperature environment to which the sorbent would be exposed in a typical cycle of the full-scale moving-bed system. Absorption was carried out at 1000°F using any of three gas compositions, all having a deliberately high H_2S concentration (1 %) to accelerate testing. The oxidative regeneration was carried out between 1000 and 1250°F and 1–21% oxygen during the early phases of regeneration, and at 1400°F during the final phase simulating the temperature rise of the sorbent bed. Sixteen zinc titanate formulations were prepared as cylindrical extrudates. For all formulations, the calcination time was held constant at 2 hours. The following results were obtained: Formulations containing a 0.8 Zn:Ti ratio produced mixtures of several stoichiometric titanates: $Zn_2Ti_3O_8$, $ZnTiO_3$, and Zn_2TiO_4, with the relative amount of each depending on temperature. Formulations containing a 2.0 Zn:Ti ratio exhibited exclusively the Zn_2TiO_4 structure. The higher calcination temperature of 1800°F significantly reduced the porosity available for chemical reactivity, while the lower calcination temperature of 1400°F produced, in some cases, formulations with traces of residual unreacted zinc oxide and anatase titanium dioxide.

4859 (DOE/MC/25006–93/C0091) **Enhanced durability of high-temperature desulfurization sorbents for fluidized-bed applications.** Gupta, R.P.; Gangwal, S.K. Research Triangle Inst., Research Triangle Park, NC (United States). [1992]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-88MC25006. (CONF-920951–32: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93002607. Source: OSTI; NTIS; GPO Dep.

The objectives of this project are to identify and demonstrate methods for enhancing long-term chemical reactivity and attrition resistance of zinc ferrite and zinc titanate sorbents to be employed for desulfurization of hot coal-derived gases in a high-temperature, high-pressure (HTHP) fluid-bed reactor. The sorbent formulation specified for study during the base period of this project was zinc ferrite. Zinc titanate sorbents are being studied under two options to the base contract. Specific objectives of the zinc titanate sorbent development work are the following: The effect of following process variables was investigated o the performance of zinc titanate sorbents: Method of sorbent preparation, Composition of fuel gas, Zn to Ti ratio of the sorbent, Sulfidation temperature, and Superficial gas velocity. The effect of first three variables has been covered in RTI's 1991 paper (Gupta and Gangwal, 1991b), while the effect of temperature and superficial gas velocity is described here.

4860 (DOE/MC/25020–3126) **Development of high energy density fuels from mild gasification of coal: Final report.** Lummus Crest, Inc., Bloomfield, NJ (United States). Dec 1991. 314p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-88MC25020. Order Number DE93000206. Source: OSTI; NTIS; GPO Dep.

METC has concluded that MCG technology has the potential to simultaneously satisfy the transportation and power generation fuel needs in the most cost-effective manner. MCG is based on low temperature pyrolysis, a technique known to the coal community for over a century. Most past pyrolysis developments were aimed at maximizing the liquids yield which results in a low quality tarry product requiring significant and capital intensive upgrading. By

properly tailoring the pyrolysis severity to control the liquid yield-liquid quality relationship, it has been found that a higher quality distillate-boiling liquid can be readily "skimmed" from the coal. The resultant liquids have a much higher H/C ratio than conventional pyrolytic tars and therefore can be hydroprocessed at lower cost. These liquids are also extremely enriched in I-, 2-, and 3-ring aromatics. The co-product char material can be used in place of coal as a pulverized fuel (pf) for power generation in a coal combustor. In this situation where the original coal has a high sulfur content, the MCG process can be practiced with a coal-lime mixture and the calcium values retained on the char can tie up the unconverted coal sulfur upon pf combustion of the char. Lime has also been shown to improve the yield and quality of the MCG liquids.

4861 (DOE/MC/25140–93/C0131) **Hot Gas Cleanup Test Facility for Gasification and Pressurized Combustion.** Sears, R.E.; Griswold, G.H.; Fankhanel, M.O.; Kastner, C.E.; Pontium, D.H. Southern Co. Services, Inc., Birmingham, AL (United States). [1992]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC21-90MC25140. (CONF-920951–40: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93003205. Source: OSTI; NTIS; GPO Dep.

Efficiencies in advanced power generation systems such as integrated gasification combined cycle, pressurized fluidized bed combustion and integrated gasification fuel cells can be maximized by feeding hot fuel gas or flue gas to the power block. However, advanced gas turbines have strict particulate requirements to minimize wear on the blades due to the close tolerances used to maximize the efficiency of the turbomachinery. Molten Carbonate Fuel Cells also have strict particulate requirements to prevent blinding of the electrodes. Therefore, one of the main barriers to developing these advanced power generation systems is the removal of particulates in a hot gas stream. Although the development of several high temperature/pressure PCD systems has been ongoing for the past several years, long term operation under realistic conditions for advanced power generation has been limited. The demonstration of reliable operation is critical to the commercialization of PCD technology for advanced power generation. The conceptual design of the Hot Gas Cleanup Test Facility Project was expanded to include additional modules to better address the scope of the Cooperative Agreement with the DOE/METC. The expanded test facility, referred to as the Power Systems Development Facility, will provide a flexible test location in which the development of advanced power system components, the evaluation of advanced turbine and fuel cell configurations, and the integration and control issues of these systems. The facility is intended to provide direct support for upcoming DOE demonstrations of power generation technologies utilizing hot stream cleanup and will provide a resource for rigorous testing and performance assessment of hot stream cleanup devices now being developed with the support of DOE/METC.

4862 (DOE/MC/25140–3159) **Hot gas cleanup test facility for gasification and pressurized combustion: Quarterly technical progress report, January 1–March 31, 1992.** Southern Co. Services, Inc., Birmingham, AL (United States). [1992]. 134p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC21-90MC25140. Order Number DE93004820. Source: OSTI; NTIS; GPO Dep.

This quarterly technical progress report summarizes work completed during the Sixth Quarter of the First Budget Period, January 1 through March 31, 1992, under the Department of Energy (DOE) Cooperative Agreement No. DE-FC21-90MC25140 entitled "Hot Gas Cleanup Test Facility for Gasification and Pressurized Combustion." The objective of this project is to evaluate hot gas particle control technologies using coal-derived gas streams. The major emphasis during this reporting period was expanding the test facility to address system integration issues of hot particulate removal in advanced power generation systems. The conceptual design of the facility was extended to include additional modules for the expansion of the test facility, which is referred to as the Power Systems Development Facility (PSOF). A letter agreement was negotiated between Southern Company Services (SCS) and Foster Wheeler (FW) for the conceptual design of the Advanced Pressurized Fluid-Bed Combustion (APFBC)/Topping Combustor/Gas Turbine System to be added to the facility. The expanded conceptual design also included modifications to the existing conceptual design for the Hot Gas Cleanup Test Facility (HGCTF), facility layout and balance of plant design for the PSOF. Southern Research Institute (SRI) began investigating the sampling requirements for the expanded facility and assisted SCS in contacting Particulate Control Device (PCD) vendors for additional information. SCS also contacted the Electric Power Research Institute (EPRI) and two molten carbonate fuel cell vendors for input on the fuel cell module for the PSDF.

4863 (DOE/MC/25140–3160) **Hot gas cleanup test facility for gasification and pressurized combustion: Quarterly technical progress report, April 1–June 30, 1992.** Southern Co. Services, Inc., Birmingham, AL (United States). [1992]. 59p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC21-90MC25140. Order Number DE93004819. Source: OSTI; NTIS; GPO Dep.

This quarterly technical progress report summarizes work completed during the Seventh Quarter of the First Budget Period, April 1 through June 30, 1992, under the Department of Energy (DOE) Cooperative Agreement No. DE-FC21-90MC25140 entitled "Hot Gas Cleanup Test Facility for Gasification and Pressurized Combustion." The conceptual design of the facility was extended to include a within scope, phased expansion of the existing Hot Gas Cleanup Test Facility Cooperative Agreement to also address systems integration issues of hot particulate removal in advanced coal-based power generation systems. This expansion will include the consideration of the following modules at the test facility in addition to the existing Transport Reactor gas source and Hot Gas Cleanup Units: Carbonizer/Pressurized Circulating Fluidized Bed Gas Source; Hot Gas Cleanup Units to mate to all gas streams. Combustion Gas Turbine; Fuel Cell and associated gas treatment; and Externally Fired Gas Turbine/Water Augmented Gas Turbine. This expansion to the Hot Gas Cleanup Test Facility is herein referred to as the Power Systems Development Facility (PSDF).

4864 (DOE/MC/25201–3124) **Cordierite silicon nitride filters: Final report.** Sawyer, J. (Acurex Environmental Corp., Mountain View, CA (United States)); Buchan, B.; Duiven, R.; Berger, M.; Cleveland, J.; Ferri, J. Acurex Environmental Corp., Mountain View, CA (United States). Feb 1992. 263p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-88MC25201. Order Number DE93000204. Source: OSTI; NTIS; GPO Dep.

The objective of this project was to develop a silicon nitride based crossflow filter. This report summarizes the findings and results of the project. The project was phased with Phase I consisting of filter material development and crossflow filter design. Phase II involved filter manufacturing, filter testing under simulated conditions and reporting the results. In Phase I, Cordierite Silicon Nitride (CSN) was developed and tested for permeability and strength. Target values for each of these parameters were established early in the program. The values were met by the material development effort in Phase I. The crossflow filter design effort proceeded by developing a macroscopic design based on required surface area and estimated stresses. Then the thermal and pressure stresses were estimated using finite element analysis. In Phase II of this program, the filter manufacturing technique was developed, and the manufactured filters were tested. The technique developed involved press-bonding extruded tiles to form a filter, producing a monolithic filter after sintering. Filters manufactured using this technique were tested at Acurex and at the Westinghouse Science and Technology Center. The filters did not delaminate during testing and operated and high collection efficiency and good cleanability. Further development in areas of sintering and filter design is recommended.

4865 (DOE/MC/25204–3133) **Gas separation with glass membranes: Final report.** Roberts, D.L.; Abraham, L.C.; Blum, Y.; Way, J.D. SRI International, Menlo Park, CA (United States). May 1992. 105p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-88MC25204. Order Number DE93000217. Source: OSTI; NTIS; GPO Dep.

The Department of Energy (DOE) is seeking to develop high temperature, high pressure inorganic membrane technology to

perform a variety of gas separation processes to improve the efficiency and economics of advanced power generation systems such as direct coal-fueled turbines (DCFT) and the integrated gasification combined cycle process (IGCC). The temperatures encountered in these power generation systems are far above the temperature range for organic membrane materials. Inorganic materials such as ceramics are therefore the most likely membrane materials for use at high temperatures. This project focussed on silica glass fiber membranes made by PPG Industries (Pittsburgh, PA). The goals were both experimental and theoretical. The first objective was to develop a rational theory for the performance of these membranes. With existing theories as a starting point, a new theory was devised to explain the unusual "molecular sieving" behavior exhibited by these glass membranes. An apparatus was then devised for making permeation performance measurements at conditions of interest to DOE (temperatures to 2000°F; pressures to 1000 psia). With this apparatus, gas mixtures could be made typical of coal combustion or coal gasification processes, these gases could be passed into a membrane test cell, and the separation performance determined. Data were obtained for H_2/CO,N_2/CO_2, $0_2/N_2$, and NH_3/N_2 mixtures and for a variety of pure component gases (He, H_2, CO_2, N_2, CO, NH_3). The most challenging part of the project turned out to be the sealing of the membrane at high temperatures and pressures. The report concludes with an overview of the practical potential of these membranes and of inorganic membranes in general of DOE and other applications.

4866 (DOE/MC/26038–93/C0105) **Facilitated transport ceramic membranes for high temperature gas cleanup.** Minford, E.; Herman, F.L.; Quinn, R. Air Products and Chemicals, Inc., Allentown, PA (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-90MC26038. (CONF-920951–21: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93002617. Source: OSTI; NTIS; GPO Dep.

The H_2S flux through a molten carbonate/ceramic membrane is expected to depend on the extent of the reaction of H_2S with the molten carbonate, that is, the equilibrium constant and K_l for reaction (1). Values of K_1 can be obtained by absorption experiments in which molten carbonate mixtures are exposed to gas mixtures containing H_2S and other IGCC gases. The details of such experiments and the apparatus used have been described previously. For the carbonate mixture described above and a feed gas mixture containing 10.7% H_2S, 6.4% CO_2, 81.1% CH_4 and 1.8% H_2, a value of K_l of 0.24 atm was obtained at 560°C. This value is reasonable when compared to the literature value of 1.7 atm at 750°C. Subsequent attempts to reproduce this result were unsuccessful. Aluminum nitride and lithium aluminate were determined to be the best choices for further development as ceramic membrane supports based on results from a series of initial screening experiments which were previously described. These experiments indicated that A1N and $LiAlO_2$ were the ceramic materials with the best chemical stability in the presence of the molten alkali carbonate mixtures. Wetting studies were used to determine the desired microstructures for salt containment. This was particularly true in the case of A1N. It was not possible to obtain or fabricate dense samples of $LiAlO_2$ for use in wetting studies; however, it is known that $LiAlO_2$ is wet by the salt compositions of interest The capillary force equation (equation 2) was used to estimate, the maximum pressure differential that the membrane could sustain without loss of the salt.

4867 (DOE/MC/26239–93/C0133) **Particulate technology issues.** Pontius, D.H.; Vann Bush, P. Southern Research Inst., Birmingham, AL (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-89MC26239. (CONF-920951–48: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93003200. Source: OSTI; NTIS; GPO Dep.

Advanced systems for power generation based on coal combustion or gasification will require effective particulate control both for protection of equipment in the gas stream and for compliance with environmental regulations. These new classes of systems will require efficient removal of particles from gas streams at high temperature and high pressure. Primary candidates for particulate control are various types of ceramic filter systems; however, the long-term effects of hot gases and fine particles on the structure and filtration effectiveness of potential filter materials require further study. Thermal gradients induced by pulse cleaning are also of concern. Long-term "patch tests" will be conducted on ceramic disks of the same materials used in the fabrication of ceramic candles and ceramic crossflow filters. The primary issues to be addressed in these tests are the long-term physical, thermal, and chemical stability of the ceramic materials; long-term pressure drop and filtration characteristics of the ceramic filters; potential for irreversible blinding of filter elements; and long term performance and reliability of auxiliary hardware, such as the tube sheet and pulse cleaning systems. Each long-term patch test will require about 3 to 4 months of nearly continuous operation.

4868 (DOE/MC/26308–93/C0081) **Combustion Engineering IGCC Repowering Project.** Andrus, H.E.; Thibeault, P.R.; Gibson, C.R. Combustion Engineering, Inc., Windsor, CT (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC21-91MC26308. (CONF-920951–12: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93002745. Source: OSTI; NTIS; GPO Dep.

C-E gasification process uses an entrained-flow, two-stage, slagging bottom gasifier. Figure 1 shows a schematic of the gasifier concept. Some of the coal and all of the char is fed to the combustor section, while the remaining coal is fed to the reducter section of the gasifier. The coal and char in the combustor is mixed with air and the fuel-rich mixture is burned creating the high temperature necessary to gasify the coal and melt the mineral matter in the coal. The slag flows through a slag tap at the bottom of the combustor into a water-filled slag tank where it is quenched and transformed into an inert, glassy, granular material. This vitrified slag is non-leaching, making it easy to dispose of in an environmentally acceptable manner. The hot gas leaving the combustor enters the second stage called the reductor. In the reducter, the char gasification occurs along the length of the reductor zone until the temperature falls to a point where the gasification kinetics become too slow. Once the gas temperature reaches this level, essentially no further gasification takes place and the gases subsequently are cooled with convective surface to a temperature low enough to enter the cleanup system. Nearly all of the liberated energy from the coal that does not produce fuel gas is collected and recovered with steam generating surface either in the walls of the vessel or by conventional boiler convective surfaces in the backpass of the gasifier. A mixture of unburned carbon and ash (called char) is carried out of the gasifier with the product gas strewn. The char is collected and recycled back to the gasifier where it is consumed. Thus, there is no net production of char which results in negligible carbon loss. The product gas enters a desulfurization system where it is cleaned of sulfur compounds present in the fuel gas. The clean fuel gas is now available for use in the gas turbine combuster for an integrated coal gasification combined cycle (IGCC) application.

4869 (DOE/MC/26365–93/C0099) **Hydrogen separation by ceramic membranes in coal gasification.** Gavalas, G.R. California Inst. of Tech., Pasadena, CA (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-90MC26365. (CONF-920951–14: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93002605. Source: OSTI; NTIS; GPO Dep.

Table 1 lists the support tubes and the deposition reactants and other conditions used to prepare seven membranes. The permeances of these membranes immediately after deposition, after twelve hours of thermal treatment at 700–750°C, and after thirteen days of additional hydrothermal treatment at 550°C under 3 atm of water vapor are listed in Table 2. Figure 1 is an Arrhenius plot of the hydrogen permeance of membrane D25 (dimer reactant, 25 A

pore support) before and after the hydrothermal treatment. The following conclusions can be drawn from the results of Tables 1 and 2. All membranes prepared in this series underwent hydrothermal treatment with the expected decrease of hydrogen permeance. Using the dimer and trimer precursors resulted in a slight improvement in hydrogen permeance and had no consistent effect on the H_2:N_2 selectivity. Using the 25 Å pore tubes improved moderately the hydrogen permeance but seemingly reduced the selectivity from about 500–1000 to about 200–300. The best permeance was obtained with membrane D25 made with 25 Å pore size tubes using the dimer precursor. This tube had hydrogen permeance 0.13 Cm^3/Cm^2-min-atm and H_2:N_2 selectivity of 200 at 500°C, after the thirteen-day hydrothermal treatment. It must be noted that the measurement of the very small nitrogen permeance is subject to considerable error, especially if there is some small leak in the system. Hence the true N_2 permeances may be considerably lower than the measurements indicate, and the reported selectivities probably significantly underestimate the true selectivities. Figure 1 shows a sharp increase in the activation energy of hydrogen permeance following deposition and hydrothermal treatment.

4870 (DOE/MC/26366–93/C0102) **A calcium oxide sorbent process for bulk separation of carbon dioxide.** Harrison, D.P.; Silaban, A.; Narcida, M.; Han, C. Louisiana State Univ., Baton Rouge, LA (United States). Dept. of Chemical Engineering. [1992]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-89MC26366. (CONF-920951–52: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93004098. Source: OSTI; NTIS; GPO Dep.

The overall project is divided into two phases. Phase I, now complete, investigated the technical feasibility of a regenerable calcium sorbent-based process for the high-temperature, high-pressure (HTHP) separation of CO_2 from coal-derived gas. A high-pressure electrobalance reactor and microgram quantities of sorbent were used in this phase of the study. Favorable results led to continuation of the project into Phase II where a laboratory-scale fixed-bed reactor involving gram quantities of sorbent and with capability for product gas analysis is being used. The possibility of the simultaneous occurrence of the water-gas shift reaction and CO_2 separation is of particular interest in Phase II. Simultaneous reactions create the possibility of a direct, one-step process for producing hydrogen from coal-derived gas.

4871 (DOE/MC/26372–93/C0103) **Development of hollow-fiber catalytic-membrane reactors for high-temperature gas cleanup.** Ma, Yi H.; Moser, M.R.; Pien, S.M. Worcester Polytechnic Inst., MA (United States). [1992]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-89MC26372. (CONF-920951–53: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93004086. Source: OSTI; NTIS; GPO Dep.

The project consist of the following main activities: (1) Design of catalytic hollow fiber membrane reactors. Single and multiple hollow-fiber membranes were studied in reactor/permeation cells made from stainless steel or quartz tubes. Modification of the hollow fiber membrane with catalysts was performed by aqueous impregnation, vapor deposition, and utilization of packed-bed reactors. (2) Investigation of gas separations and catalytic reactions in membrane reactors. Permeation of pure gases and gas mixtures was studied as a function of temperature. Pure component catalytic studies on the decomposition of H_2S was typically studied using 10% H_2S diluted in He. The H_2S and H_2 concentrations were measured in both the tube and shell sides of the membrane reactor to determine the degree of chemical equilibrium shift. (3) Process development of the cleanup system using a simulated gas stream with a composition similar to that from an IGCC system. Catalytic studies using the IGCC gas composition will be performed according to the procedure used in the H_2S experiments. The conditions for optimum conversion in a gas mixture will be investigated.

4872 (DOE/MC/27224–93/C0089) **Bench-scale testing and evaluation of the Direct Sulfur Recovery Process.** Gangwal, S.K.; McMichael, W.J.; Agarwal, S.K.; Chen, D.H.; Hopper, J.R. Research Triangle Inst., Research Triangle Park, NC (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-90MC27224. (CONF-920951–24: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93002613. Source: OSTI; NTIS; GPO Dep.

The present work seeks to (1) demonstrate the DSRP in an integrated two-stage bench-scale unit scaled up by a factor of up to 40, for up to 99 percent or higher recovery of sulfur, (2) explain the high sulfur yield and mechanism of DSRP reactions by conducting kinetic experiments and advanced thermodynamic calculations, and (3) continue technology transfer to the point where industry is willing to support further DSRP development. The DSRP Bench-Scale Unit hardware has been described in detail previously (Gangwal and McMichael, 1990; Gangwal and McMichael, 1991). The unit consists of a simulated off-gas and coal-gas delivery system connected to two high-pressure reactors and condensers in the configuration shown conceptually in Figure 1. The system is rated to 400 psig and the reactors, capable of operation at up to 400 psig at 750°C, hold up to 1 L of catalyst each. The inlet and outlet gases are analyzed using two gas chromatographs (GCs) and a continuous SO_2 analyzer. One major change recently made to the unit consists of installing advanced condensers suggested by experts in the field to facilitate more efficient separation of the sulfur after each reactor. A schematic diagram of the advanced condenser is shown in Figure 2. The sulfur-laden gas is cooled by surrounding steam at 250°F in a coil and then flashed into the sulfur collection pot for separation of gas and sulfur. A sulfur drain is included so that it is not necessary to dismantle the condenser after every run. The ability to drain the sulfur during a run allows extended runs to be carried out. Also fittings are provided in strategic locations to allow dismantling when cleanup becomes necessary.

4873 (DOE/MC/27226–93/C0108) **Development of biological coal gasification (MicGAS) process.** Walia, D.S.; Srivastava, K.C.; Barik, S. ARCTECH, Inc., Chantilly, VA (United States). [1992]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-90MC27226. (CONF-920951–20: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93002616. Source: OSTI; NTIS; GPO Dep.

Biomethanation of coal is a phenomenon carried out in concert by a mixed population (consortium) of at least three different groups of anaerobic bacteria and can be considered analogous to that of anaerobic digestion of municipal waste. The exception, however, is that unlike municipal waste; coal is a much complex and difficult substrate to degrade. This project was focused on studying the types of microorganisms involved in coal degradation, rates of methane production, developing a cost-effective synthetic culture medium for these microbial consortia and determining the rate of methane production in bench scale bioreactors.

4874 (DOE/MC/27227–93/C0130) **Gasifiers optimized for fuel cell applications.** Steinfeld, G.; Fruchtman, J.; Hauserman, W.B.; Lee, A.; Meyers, S.J. Energy Research Corp., Danbury, CT (United States). [1992]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-90MC27227. (CONF-920951–50: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93003486. Source: OSTI; NTIS; GPO Dep.

Conventional coal gasification carbonate fuel cell systems are typically configured as shown in Figure 1, where the fuel gas is primarily hydrogen, carbon monoxide, and carbon dioxide, with waste heat recovery for process requirements and to produce additional power in a steam bottoming cycle. These systems make use of present day gasification processes to produce the low to medium Btu fuel gas which in turn is cleaned up and consumed by the fuel cell. These conventional gasification/fuel cell systems have been studied in recent years projecting system efficiencies of 45–53% (HHV). Conventional gasification systems currently available evolved as stand-alone systems producing low to medium Btu gas fuel gas. The requirements of the gasification process dictates high

temperatures to carry out the steam/carbon reaction and to gasify the tars present in coal. The high gasification temperatures required are achieved by an oxidant which consumes a portion of the feed coal to provide the endothermic heat required for the gasification process. The thermal needs of this process result in fuel gas temperatures that are higher than necessary for most end use applications, as well as for gas cleanup purposes. This results in some efficiency and cost penalties. This effort is designed to study advanced means of power generation by integrating the gasification process with the unique operating characteristics of carbonate fuel cells to achieve a more efficient and cost effective coal based power generating system. This is to be done by altering the gasification process to produce fuel gas compositions which result in more efficient fuel cell operation and by integrating the gasification process with the fuel cell as shown in Figure 2. Low temperature catalytic gasification was chosen as the basis for this effort due to the inherent efficiency advantages and compatibility with fuel cell operating temperatures.

4875 (DOE/MC/27233–93/C0129) **Studies of in-situ calcium-based sorbents in advanced pressurized coal conversion systems.** Katta, S.; Shires, P.J.; O'Donnell, J.J. Kellogg (M.W.) Co., Houston, TX (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-91MC27233. (CONF-920951–41: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93003206. Source: OSTI; NTIS; GPO Dep.

The overall objective of the project is to obtain experimental data on the reactions of calcium-based sorbents in gasification systems and to evaluate or develop kinetic models applicable to the commercial design of such systems. Both air-blown coal gasification systems and second generation fluid bed combustion systems (partial gasification) will be investigated, as well as subsequent stabilization of the solid wastes (calcium sulfide/ash) produced. More specifically, the objectives are to: Develop data on kinetics of in-situ desulfurization reactions; study the effect of calcium on the kinetics of carbon conversion rate; study kinetics of oxidation of CaS to $CaSO^4$; Develop and identify viable techniques to stabilize CaS; and, carry out further development work on most promising method and determine its commercial economics.

4876 (DOE/MC/27240–93/C0115) **Production of mild gasification coproducts.** Horne, D.A.; Watson, P.A. SGI Fuels, Inc., La Jolla, CA (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-91MC27240. (CONF-920951–38: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93003203. Source: OSTI; NTIS; GPO Dep.

The LFC process upgrades young coals and lignites to a solid fuel which resembles higher rank coals and coproduces a liquid that resembles fuel oil. During the natural metamorphic process of pressure and heat, younger lower rank coals are converted to older higher rank coals over a period of greater than 100 million years. SGI's LFC process accomplishes this transformation in less than an hour, producing solid Process Derived Fuel (PDF) and liquid Coal Derived Liquid (CDL) coproducts. The coproduct samples will be produced from 4 different coals gathered from 3 major coal resource regions of the United States. Samples of the LFC process coproducts will be delivered to Government laboratories for test and characterization. Twenty kilograins of PDF will be delivered to each of 3 laboratories and 2 laters of CDL will be delivered to each of 4 laboratories. The characterization information will be returned to SGI and then will be incorporated into the final report.

4877 (DOE/MC/27339–93/C0112) **Current status of design and construction of ENCOAL Mild Gasification Plant.** Frederick, J.P.; Siddoway, M.A.; Coolidge, D.W. Encoal Corp., Gillette, WY (United States). [1992]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC21-90MC27339. (CONF-920951–30: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93002610. Source: OSTI; NTIS; GPO Dep.

The ENCOAL project is demonstrating for the first time the integrated operation of several process steps: a. Coal drying on a rotary grate using convective heatin; b. Coal devolatilization on a rotary grate using convective heating; c. Hot particulate removal with cyclones integral solids cooling; and deactivation-passivation; e. Combustors operating on low-Btu gas from internal streams; f. Solids stabilization for storage and shipment; g. Computer control and optimization of a mild coal gasification process. The product fuels are expected to be used economically in commercial boilers and furnaces and to significantly reduce sulfur emissions at industrial and utility facilities currently burning high sulfur bituminous fuels or fuel oils thereby reducing acid rain-causing pollutants. The design and construction of the ENCOAL demonstration plan was done on a fast track basis, that is, these activities were extensively overlapped.

4878 (DOE/MC/27363–93/C0082) **Tampa Electric Company Integrated Gasification Combined Cycle Project.** Pless, D.E.; Black, C.R. Tampa Electric Co., FL (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC21-91MC27363. (CONF-920951–23: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93002619. Source: OSTI; NTIS; GPO Dep.

The proposed project will utilize commercially available gasification technology as provided by Texaco in their licensed oxygen-blown entrained-flow gasifier. In this arrangement, coal is ground to specification and slurried in water to the desired concentration (60–70% solids) in rod mills. This coal slurry and an oxidant (95 % pure oxygen) are then mixed in the gasifier burner where the coal partially combusts, in an oxygen deficient environment, to produce syngas with a heat content of about 250 BTU/SCF (LHV) at a temperature in excess of 2500°F. The oxygen will be produced from an Air Separation Unit (ASU). The gasifier is expected to achieve greater than 95% carbon conversion in a single pass. It is currently planned for the gasifier to be a single vessel feeding into one radiant syngas cooler where the temperature will be reduced from about 2500°F to about 1300°F. After the radiant cooler, the gas will then be split into two (2) parallel convective coolers, where the temperature will be cooled further to about 900°F. One stream will go to the 50% HGCU system and the other stream to the traditional CGCU system with 100% capacity. This flow arrangement was selected to provide assurance to Tampa Electric that the IGCC capability would not be restricted due to the demonstration of the HGCU system. A traditional amine scrubber type system with conventional sulfur recovery will be used. Sulfur from the HGCU and CGCU systems will be recovered in the form of H_2SO_4 and elemental sulfur respectively.The key components of the combined cycle are the advanced combustion.turbine (CT), heat recovery steam generator (HRSG), and steam turbine (ST), and generators. The advanced CT will be a GE 7F operating with a firing temperature of about 2300°F.

4879 (DOE/MC/27391–93/C0110) **Scaleup of mild gasification to a process development unit.** Campbell, J.A.L.; Carty, R.H.; Saladin, N.; Mead, J.; Foster, H. Kerr-McGee Coal Corp., Oklahoma City, OK (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC21-92MC27391. (CONF-920951–11: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93002744. Source: OSTI; NTIS; GPO Dep.

The overall objectives of this project is to develop the IGT Mild-Gasification (MILDGAS) process for near-term commercialization. The specific objectives of the program are to: design, construct, and operate a 24-tons/day adiabatic process development unit (PDU) to obtain process performance data suitable for further design scaleup obtain large batches of coal-derived co-products for industrial evaluation prepare a detailed design of a demonstration unit develop technical and economic plans for commercialization of the MILDGAS process. During the first ten months of this project. the NEPA Application for construction and operation of the PDU facility at the SIUC site was written and submitted for approval. In

addition, the process design for the PDU was completed, bid packages for the PDU modules were prepared and sent to a slate of prospective bidders, and bids were received from the participating bidders.

4880 (DOE/MC/28202–93/C0113) **Gasification Product Improvement Facility (GPIF).** Sadowski, R.S.; Brooks, K.S.; Skinner, W.H.; Brown, M.J. CRS Sirrine Engineers, Inc., Greenville, SC (United States). [1992]. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-92MC28202. (CONF-920951–34: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93002742. Source: OSTI; NTIS; GPO Dep.

The objective is to provide a test facility to support early commercialization of advanced fixed-bed coal gasification technology electric power generation applications. The proprietary CRS Sirrine Engineers, Inc. PyGas™ staged gasifier has been selected as the initial gasifier to be developed under this program. The gasifier is expected to avoid agglomeration when used on caking coals. It is also being designed to crack tar vapors and ammonia, and to provide an environment in which volatilized alkali may condense onto aluminosilicates in the coal ash thereby minimizing their exiting with the hot raw coal gas and passing through the system to the gas turbine. The management plan calls for a three phased program. The initial phase (Phase 1), includes the CRS Sinine Engineers, Inc. proprietary gasification invention called PyGas™, necessary coal and limestone receiving/storage/reclaim systems to allow closely metered coal and limestone to be fed into the gasifier for testing. The coal gas is subsequently piped to and combusted in an existing burner of the Monongahela Power Fort Martin Generating Station Unit No. 2. Continuous gasification process steam is generated by a small GPIF packaged boiler using light oil fuel at startup, and by switching from light oil to coal gas after startup. The major peripheral equipment such as foundations, process water system, ash handling, ash storage silo, emergency vent pipe, building, lavatory, electrical interconnect, control room, provisions for Phases II & III, and control system are all included in Phase I. A future hot gas cleanup unit conceptualized to be a zinc ferrite based fluidized bed process constitutes the following phase (Phase H). The final phase (Phase III) contemplates the addition of a combustion turbine and generator set sized to accommodate the parasitic load of the entire system.

4881 (DOE/MC/29310–93/C0084) **Wabash River Coal Gasification Repowering Project.** Amick, P.; Mann, G.J.; Cook, J.J.; Fisackerly, R.; Spears, R.C. Wabash Coal Gasification Repowering Project Joint Venture, Houston, TX (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC21-92MC29310. (CONF-920951–9: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93002741. Source: OSTI; NTIS; GPO Dep.

The Destec gasification process features an oxygen-blown, two stage entrained flow gasifier. PSI will procure coal for the Project consistent with the design specification ranges of Destec's coal gasification facility. Destec's plant will be designed to accept coal with a maximum sulfur content of 5.9% (dry basis) and a minimum energy content of 13,5000 BTU/pound (moisture and ash free basis). PSI and Destec will test at least two other coals for significant periods during the demonstration period. In the Destec process, coal is ground with water to form a slurry. It is then pumped into a gasification vessel where oxygen is added to form a hot raw gas through partial combustion. Most of the noncarbon material in the coal melts and flows out the bottom of the vessel forming slag – a black, glassy, non-leaching, sand-like material. Particulates, sulfur and other impurities are removed from the gas before combustion to make it acceptable fuel for the gas turbine. The synthetic fuel gas (syngas) is piped to a General Electric MS 7001F high temperature combustion turbine generator. A heat recovery steam generator recovers gas turbine exhaust heat to produce high pressure steam. This steam and the steam generated in the gasification process supply an existing steam turbine-generator. The plant will be designed to outperform air emission standards established by the Clean Air Act Amendments for the year 2000.

4882 (DOE/METC/C–93/7036) **Overview of the United States DOE Surface Gasification Program.** Schmidt, D.K. Department of Energy, Morgantown, WV (United States). Morgantown Energy Technology Center. [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). (CONF-9210211–1: U.S.-Japan joint technical meeting on coal gasification, San Francisco, CA (United States), 10-13 Oct 1992). Order Number DE93002397. Source: OSTI; NTIS; GPO Dep.

The US Department of Energy's (DOE) Strategic Plan for Advanced Coal Technology envisions that by 2030 the use of coal will double, achieving a level of 2 billion ton-per-year, and will be predominately for power generation. Advanced clean coal technologies are essential to this continued use of vast reserves of domestic coal – an economic, stable, and efficient fuel. Integrated Gasification Combined Cycle (IGCC) is one of several technologies that are key to DOE's strategy – to reverse a currently inaccurate, negative image of coal – and to update the public view to the realization that with new technologies, coal truly is a clean fuel of choice. The 21st century vision of coal depicts a fuel that can be stored and transported in an environmentally clean and aesthetically acceptable manner to supply reliable, reasonably priced electric power and other products that can be used cleanly and efficiently. Coal gasification is at the center of this coal utilization strategy and is essential to advanced clean, highly efficient technologies such as IGCC, advanced pressurized fluidized-bed combustion, integrated gasification fuel cell and fuel and chemical reduction.

4883 (DOE/METC/C–93/7037) **High efficiency clean coal technology products: Status of development and demonstration.** Salvador, L.A.; Mahajan, K. USDOE Morgantown Energy Technology Center, WV (United States). [1992]. 22p. Sponsored by USDOE, Washington, DC (United States). (CONF-921037–7: 9. annual international Pittsburgh coal conference, Pittsburgh, PA (United States), 12-16 Oct 1992). Order Number DE93002398. Source: OSTI; NTIS; GPO Dep.

The US Department of Energy (DOE) has been working with the private sector for many years fostering the development and commercialization of clean, efficient, and cost-effective coal utilization technologies which do not compromise environmental quality. This effort has been accomplished through an integrated program of research, development, and demonstration beginning at the laboratory scale and culminating in commercial-scale demonstrations. The Morgantown Energy Technology Center (METC) has DOE's lead responsibility for developing several of these advanced power generation products as well as products for the production of new fuel forms from coal. These products include integrated gasification combined cycle (IGCC), advanced pressurized fluidized-bed combustion (PPSC), externally fired combined cycles (EFCC), mild gasification, integrated gasification fuel cells (IGFC), and advanced gas turbine systems (ATS). This paper will give an overview of the DOE strategy and programs to develop, demonstrate, and commercialize these technological products which will allow the United States to continue to make use of its vast domestic coal resources and enhance environmental quality.

4884 (DOE/METC/C–93/7040) **METC integrated bench scale gasification and hot gas cleanup studies.** Rockey, J.M. (USDOE Morgantown Energy Technology Center, WV (United States)); Kanosky, J.P.; Rutten, J. USDOE Morgantown Energy Technology Center, WV (United States); EG and G Washington Analytical Services Center, Inc., Morgantown, WV (United States). [1992]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-90MC26328. (CONF-920951–8: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93002395. Source: OSTI; NTIS; GPO Dep.

The cleanup test section consists of a closely coupled modular gas cleanup rig (MGCR) which was acquired from The Institute of Gas Technology. The MGCR receives coal-derived gas at 425 psig and 1,000°F from the METC Fluid-Bed Gasifier. The gas pressure is reduced to approximately 300 psia, reheated to 1,200°F, and filtered by a candle filter vessel containing up to four filter cartridges.

For batch-mode test operations, the filtered coal gas is fed into a 6-inch ID, fluid-bed reactor that is preloaded with desulfurization sorbent. Batch-mode sulfidation tests demonstrated that the prospects for developing an effective fluid-bed hot-gas desulfurization system are promising, since H_2S removal of greater than 99 percent was consistently shown with sorbent utilization up to 25 percent. Conversely, the regeneration conducted in the batch mode MGCR was not useful because the regeneration occurs too quickly, and thus process concerns cannot be suitably evaluated in the batch fluid-bed mode reactor. Pursuant to batch mode tests, the gas cleanup system is being modified to incorporate a reactor in parallel with the batch reactor so that solids can be fed into and withdrawn from the reactor without impacting batch mode operation in the meantime. The new reactor setup which allows for through-flow of solid sorbent during operation is also being designed to operate using smaller (70–150 micron) particles in addition to the larger (200–300 micron) particles used in prior tests.

4885 (DOE/PC/88812–T15) **Process and analytical studies of enhanced low severity co-processing using selective coal pretreatment: Final technical report.** Baldwin, R.M.; Miller, R.L. Colorado School of Mines, Golden, CO (United States). Dept. of Chemical Engineering and Petroleum Refining. Dec 1991. 156p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-88PC88812. Order Number DE93004915. Source: OSTI; NTIS; GPO Dep.

The findings in the first phase were as follows: 1. Both reductive (non-selective) alkylation and selective oxygen alkylation brought about an increase in liquefaction reactivity for both coals. 2. Selective oxygen alkylation is more effective in enhancing the reactivity of low rank coals. In the second phase of studies, the major findings were as follows: 1. Liquefaction reactivity increases with increasing level of alkylation for both hydroliquefaction and co-processing reaction conditions. 2. the increase in reactivity found for O-alkylated Wyodak subbituminous coal is caused by chemical changes at phenolic and carboxylic functional sites. 3. O-methylation of Wyodak subbituminous coal reduced the apparent activation energy for liquefaction of this coal.

4886 (DOE/PC/88920–T24) **Effect of Heavy metals on the iron oxidizing ability of Thiobacillus ferrooxidans: Part 1, Effect of silver: Technical progress report, July 1992–September 1992.** De, G.C.; Pesic, B. Idaho Univ., Moscow, ID (United States). Dept. of Metallurgical and Mining Engineering. [1992]. 39p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-88PC88920. Order Number DE93004939. Source: OSTI; NTIS; GPO Dep.

The effect of silver ions on the iron oxidizing ability of Thiobacillus ferrooxidans was studied using electrochemical and other physics-chemical techniques. Electrochemical investigation was conducted using a method based on redox potential change. Experiments were performed by adding an aliquot of separately prepared concentrate of the bacteria into the solution of ferrous ion and monitoring the redox potential for at least one hour. Pyrite was used as the indicator electrode. Parameters examined were pH, microbial cell density, ferrous, ferric and silver ion concentration, temperature and preconditioning period of the bacteria with silver ions, etc. Results obtained demonstrate that the rate of ferrous ion oxidation is dependent on pH (optimum pH range is 1.5–2.0) and the substrate (i.e. Fe(II)) to microbial cell concentration ratio. The mechanism of the bacteria mediated oxidation of ferrous iron is remarkably sensitive to temperature changes. At the vicinity of the optimum temperature (i.e. 25°C), the reaction is likely to be controlled by the diffusion of Fe (II) ions through the cell wall of the bacteria, whereas below the range 18–25°C, reaction kinetics may be the rate controlling factor. In the presence of 10 mg/L silver, the reaction may be kinetically controlled over the temperature range 5.5–25°C. Inhibition of microbial FE(II) oxidation in the presence of silver may take place via a mixed mechanism in which silver may bind with both the enzyme and the enzyme-substrate complex.

4887 (DOE/PC/90033–22) **Advanced Coal Liquefaction Research and Development Facility, Wilsonville, Alabama: Run 262 with Black Thunder subbituminous coal: Technical progress report.** Southern Co. Services, Inc., Birmingham, AL (United States); Southern Electric International, Inc., Wilsonville, AL (United States). Sep 1992. 208p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-90PC90033. Order Number DE93004920. Source: OSTI; NTIS; GPO Dep.

This report presents the results of Run 262 performed at the Advanced Coal Liquefaction R&D Facility in Wilsonville, Alabama. The run started on July 10, 1991 and continued until September 30, 1991, operating in the Close-Coupled Integrated Two-Stage Liquefaction mode processing Black Thunder Mine subbituminous coal (Wyodak-Anderson seam from Wyoming Powder River Basin). A dispersed molybdenum catalyst was evaluated for its performance. The effect of the dispersed catalyst on eliminating solids buildup was also evaluated. Half volume reactors were used with supported Criterion 324 1/16" catalyst in the second stage at a catalyst replacement rate of 3 lb/ton of MF coal. The hybrid dispersed plus supported catalyst system was tested for the effect of space velocity, second stage temperature, and molybdenum concentration. The supported catalyst was removed from the second stage for one test period to see the performance of slurry reactors. Iron oxide was used as slurry catalyst at a rate of 2 wt % MF coal throughout the run (dimethyl disulfide (DMDS) was used as the sulfiding agent). The close-coupled reactor unit was on-stream for 1271.2 hours for an on-stream factor of 89.8% and the ROSE-SR unit was on-feed for 1101.6 hours for an on-stream factor of 90.3% for the entire run.

4888 (DOE/PC/90300–T7) **Rapid pressure swing absorption cleanup of post-shift reactor synthesis gas: Technical progress report, April 1, 1992–July 31, 1992.** Sirkar, K.K.; Majumdar, S.; Bhaumik, S. Stevens Inst. of Tech., Hoboken, NJ (United States). Dept. of Chemistry and Chemical Engineering; New Jersey Inst. of Tech., Newark, NJ (United States). Dept. of Chemical Engineering, Chemistry and Environmental Science. 24 Sep 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-90PC90300. Order Number DE93004932. Source: OSTI; NTIS; GPO Dep.

This investigation is concerned with the separation of gas mixtures using a novel concept of rapid pressure swing absorption (RAPSAB) of gas in a stationary absorbent liquid through gas-liquid interfaces immobilized in the pore mouths of hydrophobic microporous membranes. The process is implemented in a module well-packed with hydrophobic microporous hollow fiber membranes. Before we proceed to RAPSAB studies with reactive absorbents, it is necessary to make an effort to compare experimental results with those predicted by the models. The only model developed so far involved a type of RAPSAB cycle (Mode 3) for which limited data were acquired earlier. A number of experiments have, therefore, been conducted in this mode to characterize the absorption part of the cycle. A new and more compact module (Module No. 5) was made using 840 fibers and a teflon casing inside the stainless steel shell to exactly define the fiber packing density. This allows an exact calculation of Happel's free surface radius. Experiments were carried out using a CO_2-N_2 mixture of around 10% CO_2 and balanced N_2 using both modules 4 and 5 over a wide range of absorption times.

4889 (DOE/PC/91026–T5) **The dual role of oxygen functions in coal pretreatment and liquefaction: Crosslinking and cleavage reactions: Fifth quarterly report, April 1, 1992–June 30, 1992.** Serio, M.A.; Kroo, E.; Teng, H.; Charpenay, S.; Solomon, P.R. Advanced Fuel Research, Inc., East Hartford, CT (United States). [1992]. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-91PC91026. Order Number DE93004931. Source: OSTI; NTIS; GPO Dep.

Preparation of ion-exchanged (including barium, calcium and potassium) demineralized Zap and Wyodak has been completed. Both vacuum dried and moist samples were prepared, using procedures described previously. The modified samples were subjected to functional group analysis as KBr pellets with FT-IR, and programmed pyrolysis analysis with TG-FTIR. Liquefaction experiments of these samples were also performed and products were analyzed. The data show that both the pyrolytic tar and liquefaction yields decrease with the extent of ion-exchange, i.e., in the order of (demineralized) > (ion-exchanged at pH 8) > (ion-exchanged at pH 12.5). For the pyrolysis of vacuum dried samples, the tar yield was higher for the potassium-exchanged coals than the calcium

and barium-exchanged samples, suggesting that bivalent cations tighten the coal structure by cross-linking coal fragments and make it more difficult for tar molecules to escape. The liquefaction results show that the potassium-exchanged samples have higher liquefaction yields (especially asphaltenes) than for the barium- and calcium-exchanged samples. This can probably be attributed to the same reason for the high pyrolytic tar yield, i.e., that bivalent cations can serve as a cross-linking agents to tighten the coal structure. Remoisturization of vacuum dried Zap and Wyodak was done in the attempt to understand if moisture uptake for low rank coals is a reversible process and to see if moisture influences the role of the cations. Preliminary results show that the moisture content can reach that of the raw samples by remoisturization for Zap, but not for Wyodak. Furthermore, the chemical structure of the coal samples seems to have been changed by remoisturization, since different CO_2 evolution behaviors were observed.

4890 (DOE/PC/91039–T4) **Highly dispersed catalysts for coal liquefaction: Quarterly report No. 4, May 23, 1992–August 22, 1992.** Hirschon, A.S.; Wilson, R.B. SRI International, Menlo Park, CA (United States). 5 Nov 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-91PC91039. Order Number DE93004930. Source: OSTI; NTIS; GPO Dep.

The objectives of this project are to study the effect of pretreatment methods on the two-stage liquefaction process. In particular, the effects of dispersed catalysts and carbon monoxide atmospheres on a coal liquefaction process. The project is divided into three technical tasks. Task 1 and 2 deal with the analyses and liquefaction experiments, respectively, whereas Task 3 deals with the economic impact of utilizing the pretreatment methods. This quarter we concentrated on Tasks 1 and 2, which are summarized below. Samples of Black Thunder Subbituminous coal and the corresponding recycle solvent were received from Wilsonville. These particular samples were obtained from run #263. The samples were analyzed for a proximate and ultimate analysis, as well as heat content. We have also received samples of the iron oxide used in the Wilsonville coal liquefaction runs as well as Shell 324 and molyVanL for use in future runs. Base-line screening experiments were conducted in 300 mL autoclaves using 2.5 parts by weight of recycle solvent to 1 part Black Thunder coal at 425°C for one hour. In preliminary results for the comparison of iron oxide and iron carbonyl, the iron carbonyl appears to give higher yields to soluble products.

4891 (DOE/PC/91042–T2) **Effects of low-temperature catalytic pretreatments on coal structure and reactivity in liquefaction: Technical progress report, August 1992–July 1992.** Song, C.; Saini, A.K.; Huang, L.; Wenzel, K.; Hou, L.; Hatcher, P.G.; Schobert, H.H. Pennsylvania State Univ., University Park, PA (United States). Dept. of Materials Science and Engineering. Aug 1992. 97p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-91PC91042. Order Number DE93004362. Source: OSTI; NTIS; GPO Dep.

Low-temperature catalytic pretreatment is a promising approach to the development of an improved liquefaction process- This work is a fundamental study on effects of pretreatments on coal structure and reactivity in liquefaction. The main objectives of this project are to study the coal structural changes induced by low-temperature catalytic and thermal pretreatments by using spectroscopic techniques; and to clarify the pretreatment-induced changes in reactivity or convertibility of coals in the subsequent liquefaction. This report describes the recent progress of our work. Substantial progress has been made in the spectroscopic characterization of structure and pretreatment-liquefaction reactions of a Montana subbituminous Coal (DECS-9), and thermochemical analysis of three mw and reacted bituminous coals. Temperature programmed liquefaction has been performed on three low-rank coals both in the presence and absence of dispersed molybdenum sulfide catalyst. We also performed a detailed study of the effects of mild thermal pretreatment – drying in air and in vacuum – on thermal and catalytic liquefaction of a Wyodak subbituminous coal. Important information on structure and structure transformation during thermal pretreatment and liquefaction reactions of low-rank coals has been derived by applying solid-state CPMAS ^{13}C NMR and flash pyrolysis-GC-MS (Py-GC-MS) for characterization of the macromolecular network of a Montana subbituminous coal and its residues from temperature-programmed and nonprogrammed liquefaction (TPL and N-PL) at final temperatures ranging from 300 to 425°C in H-donor and non-donor solvents. The results revealed that this coal contains significant quantities of oxygen-bearing structures, corresponding to about 18 O-bound C per 100 C atoms and one O-bound C per every 5 to 6 aromatic C.

4892 (DOE/PC/91287–6) **Supercritical thermodynamics of sulfur and nitrogen species: Quarterly progress report, July 1, 1992–September 30, 1992.** Eckert, C.A. Georgia Inst. of Tech., Atlanta, GA (United States). School of Chemical Engineering. 1 Oct 1991. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-91PC91287. Order Number DE93005990. Source: OSTI; NTIS; GPO Dep.

Significant opportunity exists for the application of supercritical fluid (SCF) technology to coal processing, both for pretreatment of high sulfur coals, as well as liquefaction and treatment of coal liquids. Supercritical fluids are attractive solvents for a variety of coal processing applications because of their unusual solvating and mass transfer properties. Solubility studies have been carried out for a number of model coal and coal-liquid compounds, primarily in pure supercritical fluids. We are extending this database of model coal compound equilibria using modern techniques that have the advantage of being much more rapid than traditional techniques. Cosolvent effects on solubility are being investigated over a variety of solvent properties. In addition, specific molecular interactions are being investigated through spectroscopic techniques. The resulting data are being used to develop a chemical-physical equation of state (EOS) model of SCF solution with meaningful parameters. The equation of state will be used to predict solubility behavior, which will permit the desip and tailoring of SCF cosolvent systems for specific coal processing applications.

4893 (DOE/PC/91301–4) **Ethanol synthesis and water gas shift over bifunctional sulfide catalysts: Technical progress report, June 1992–August 1992.** Klier, K.; Herman, R.G.; Deemer, M. Lehigh Univ., Bethlehem, PA (United States). Sep 1992. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-91PC91301. Order Number DE93006011. Source: OSTI; NTIS; GPO Dep.

During this quarter, high pressure (up to 100 atm = 10.3 MPa), high temperature (up to 350°C) catalyst testing was carried out with the 20 Wt% CS/MoS_2 catalyst that was prepared. It was verified that this is an active catalyst for the synthesis of linear C_1-C_4 alcohols and that the yield increases with increasing temperature. However, the product selectivity is shifted toward enhanced hydrocarbon production, principally of methane. Temperature, pressure, and flow rate dependences of the synthesis reactions were also investigated in the presence and absence of H_2S in the H_2/CO = 1/1 Synthesis gas during short term testing experiments. The temperature seemed to produce the largest effect on alcohol yield and on the hydrocarbon selectivity, with both increasing with increasing temperature. The presence of 45.5 ppM H_2S in the synthesis gas did increase the C_2^+ alcohol/methanol molar ratio at 285°C, but this effect was not noticeable at higher temperatures under the reaction conditions that were employed. On the other hand, the presence of H_2S decreased the yield of methane at high temperatures (340–350°C), but this effect was not noticeable at the lower temperatures that were utilized. At high temperature and pressure (350°C and 10.3 MPa) with 45.5 ppM H_2S in the synthesis gas, it was shown that increasing the gas hourly space velocity of the synthesis gas reactant significantly decreased the yield of methane, while affecting the yield of alcohols to a much lesser extent.

4894 (DOE/PC/91311–T4) **Configurational diffusion of asphaltenes in fresh and aged catalysts extrudates: Quarterly progress report, June 20, 1992–September 20, 1992.** Guin, J.A.; Tarrer, A.R. Auburn Univ., AL (United States). Dept. of Chemical Engineering. [1992]. 38p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-91PC91311. Order Number DE93004925. Source: OSTI; NTIS; GPO Dep.

The objective of this research is to determine the relationship between the size and shape of coal and petroleum macromolecules and their diffusion rates i.e., effective diffusivities, in catalyst pore structures. That is, how do the effective intrapore diffusivities depend on molecule configuration and pore geometry. Based on the

work done, the following conclusions can be drawn: The intrapore diffusional model can be set up mathematically based on certain assumptions, and the mathematical model can be solved numberically; the numerical solution discussed in this quarterly report can be used for typical situations given suitable values for parameters E, R and n; comparison with known solutions for special cases shows the numerical solution to be accurate.

4895 (DOE/SF/00098–93/C0114) **Catalytic gasification fundamentals.** Heinemann, H.; Somorjai, G.A. Lawrence Berkeley Lab., CA (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-920951–33: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93002609. Source: OSTI; NTIS; GPO Dep.

Last year it was found that Maya coke gasification could be greatly accelerated if the coking took place in the presence of small amounts (below 1%) of caustic. When the Maya coke thus prepared was impregnated with 1% of CaO-KO_x catalyst, the rate of gasification was doubled. During the past year, this phenomenon has been further investigated and the work has been extended to two other and very different cokes. As shown in Figure 2, a Statfjord Bottoms coke prepared in the presence of 1% NaOH and then impregnated with CaO_x-KO_x catalyst gasified very much faster than the same material coked in the absence of NaOH. The same phenomenon is exhibited in Figure 3 for a Torrance Hondo coke, although in this case the difference between the cokes prepared in the presence and absence of NaOH is somewhat smaller. It is concluded that the preparation method of the coke is of major importance for the rate of gasification and that the phenomenon that presence of alkali during coking is helpful is a generic one.

4896 (PNL-SA–21443) **Synthesis and reactivity of ultrafine coal liquefaction catalysts.** Linehan, J.C.; Matson, D.W.; Fulton, J.L.; Bean, R.M.; Darab, J.G. Pacific Northwest Lab., Richland, WA (United States). Oct 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9210211–2: U.S.-Japan joint technical meeting on coal gasification, San Francisco, CA (United States), 10-13 Oct 1992). Order Number DE93004326. Source: OSTI; NTIS; GPO Dep.

The Pacific Northwest Laboratory is currently developing ultrafine iron-based coal liquefaction catalysts using two new particle production technologies: (1) modified reverse micelles (MRM) and (2) rapid thermal decomposition of solutes (RTDS). These methodologies have been shown to allow control over both particle size (from 1 nm to 60 nm) and composition when used to produce ultrafine iron-based materials. Powders produced using these methods are found to be selective catalysts for carbon-carbon bond scission using the naphthyl bibenzylmethane model compound, and to promote the production of THF soluble coal products during liquefaction studies. This report describes the materials produced by both MRM and the RTDS methods and summarizes the results of preliminary catalysis studies using these materials.

4897 (TVA-Bull–Z-324) **Coal gasification for the coproduction of electricity and fertilizer.** Kelly, D.A.; Nichols, D.E.; Faucett, H.L. Tennessee Valley Authority, Muscle Shoals, AL (United States). [1992]. 14p. Sponsored by Tennessee Valley Authority, Knoxville, TN (United States). (CONF-921104–8: American Institute of Chemical Engineers annual meeting, Miami, FL (United States), 1-6 Nov 1992). Order Number DE93003914. Source: OSTI; NTIS.

TVA is proposing to develop and commercially demonstrate the coproduction of electricity and fertilizer (urea) using integrated gasification/combined cycle (IGCC) technology. The coal-based coproduction demonstration project will show that the coproduction process can economically and environmentally enhance the production of both electric power and urea. As conceptualized, the proposed coproduction demonstration project facility would be designed for a nominal electrical capacity of about 250 megawatts (MW). Table I. During normal operation, the facility would produce about 150 MW of base-load electrical power and 1,000 tons per day of urea. Sulfur from the coal would be recovered as elemental sulfur. During peak power demand, the fertilizer capacity could be reduced or bypassed and the full 250 MW could be made available. This scheme would allow continuous operation of the gasifier at 100% of its rated capacity which would reduce the annual revenue requirements for power generation by permitting the production of fertilizer. As TVA's vision of this proposal matures (i.e., as consideration is given to alternative schemes, as TVA reviews its power demands, and as more detailed engineering estimates are developed), the nature and scope of cyclic-operation may be altered.

0105 Products and By-Products

Refer also to citation(s) 4856, 4904

0106 Properties and Composition

Refer also to citation(s) 4851, 4853, 4854, 4946, 4956, 5246

4898 (DOE/MC/10637–93/C0120) **Thermal conductivity of coal ashes and slags.** Steadman, E.N.; Benson, S.A.; Nowok, J.W. North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center. [1992]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC21-86MC10637. (CONF-920951–55: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93004095. Source: OSTI; NTIS; GPO Dep.

Generally, heat in solids is conducted by the free electrons in metals and alloys at low temperatures, by thermal vibrations of atoms that are observed in the stoichiometric dielectrics, by the free electrons and holes as well as lattice vibrations at the sufficiently high temperatures recorded in semiconductors, and also by ions in amorphous materials at high temperatures. In our case, the linear variations of both thermal and electrical conductivities suggest also that ionization of point defects related to nonstoichiometry, impurities, and dopants plays some role in the thermal conductivity at intermediate and high temperatures. They create free carriers, such as electrons and holes, with concentrations that increase with temperature. The magnitude of this electronic component of thermal conductivity is very low, since σ/k is about 10^{-6}. Also, there is reason to expect the existence of electrically charged ceramic particles in a liquid-phase sintering medium that may introduce free charges. The ionic component in heat transfer, related to the diffusion of alkali ions, does not play any major role in this range of temperature and can be neglected. This component may take place above some critical temperature, across the surface, or through the volume of the material and is strongly dependent on the glass structure. Figure 7 shows the effect of porosity on the thermal conductivity of Beulah coal ash. Thermal conductivity decreases with the increase of porosity.

4899 (DOE/OR/21400–T472) **Analytical characterization of coal surfaces and interfaces: Final report.** Fuller, E.L.; Tennery, V.J.; Nolan, T.A.; Allard, L.F.; Choudhury, A. Oak Ridge National Lab., TN (United States). Jan 1992. 58p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93004463. Source: OSTI; NTIS; GPO Dep.

Diffuse reflectance infrared spectroscopy (DRIS) was used as a major instrumental technique for studying spectral regions in all of the coals of the Argonne Premium Coal Sample (APCS) set to obtain information regarding stretching and bending frequencies of the various bond types found in the coals represented by this highly standardized set of coal specimens. This technique clearly delineates the 0-H stretching frequencies from about 3500 to 2500 wave numbers. It was also a good tool for studying the complex frequency regime from about 2000 to 500 wave numbers, representing a dense regime of bending modes. Fourier seer deconvolution was used to distinguish details in the "hydrocarbon" spectral region around 3000 wave numbers. Pocahontas No. 3 coal was found to have a minimum of seven spectral peaks in this region. The "coalification" of the various materials in the APCS was clearly discernible from the details observed in the region near 3000 wave numbers. For example, Beulah Zap, a lignite, and Wyodak, a sub-bituminous, both presented relatively simple and weak spectral responses in the 0-H stretching frequency range, whereas Upper Freeport, a medium volatiles bituminous, and Pocahontas No. 3, low volatile bituminous, both exhibited rich spectral detail in this region. Studies of coal samples were carried out to determine

the initial effects of oxidation upon the coal structures. These oxidations were often carried out at 300°C for periods up to 200 h. Large changes were observed in the spectra near 3000 wave numbers, indicating the oxidation of the coal surface from these exposures. Transmission electron microscopy techniques were developed for characterizing the interfaces between included minerals and the coal structure in a number of the coals, but most of the effort was focused on Pittsburgh No. 8, a high volatile bituminous which was considered representative of many bituminous coals.

4900 (DOE/PC/89883–57) **Coal liquefaction process streams characterization and evaluation: Characterization of coal liquefaction resids employing thermogravimetric analysis and electron spin resonance spectroscopy.** Ibrahim, M.M. (West Virginia Univ., Morgantown, WV (United States). Dept. of Physics); Seehra, M.S. Consolidation Coal Co., Library, PA (United States). Research and Development Dept.; West Virginia Univ., Morgantown, WV (United States). Dept. of Physics. Oct 1992. 98p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-89PC89883. Order Number DE93004918. Source: OSTI; NTIS; GPO Dep.

This study demonstrated the feasibility of using temperature-programmed electron spin resonance (ESR) and thermogravimetric analysis (TGA) for the examination of tetrahydrofuran (THF)-soluble distillation resid materials derived from direct coal liquefaction. TGA is used to quantitate volatile losses in a temperature-programmed experiment. The TGA data are used to correct the free radical densities obtained by ESR as volatile material is evolved from the samples in the temperature-programmed ESR experiment. The techniques, when employed in tandem, can be used to determine the content and nature of the free radicals in the samples at temperatures approximating those used in the liquefaction process. TGA and ESR experiments were performed in flowing nitrogen and hydrogen, at ambient pressure. No significant difference was observed in the ESR spectra in the different atmospheres, except in the case of low-rank coal-derived resids. The TGA results, however, were systematically different; mass loss in an H_2 atmosphere is consistently higher than that observed in an N_2 atmosphere. It was shown that temperature-programmed ESR, which can pinpoint conditions at which the free radical content is the highest, has potential to be a guide for the appropriate choice of conditions for optimum resid upgrading. Further development of these combined analytical methods as process development tools appears justified based on these results.

4901 (DOE/PC/90290–8) **Advanced NMR approaches in the characterization of coal: [Quarterly] report No. 8.** Maciel, G.E. Colorado State Univ., Fort Collins, CO (United States). Dept. of Chemistry. [1992]. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-90PC90290. Order Number DE93006009. Source: OSTI; NTIS; GPO Dep.

The paper submitted earlier on the use of (bicyclo[3.2.1]4pyrrolidino-N-methyl-octan-8-one triflate) (^{13}CO-123) as a ^{13}C intensity standard was accepted for publication. Subsequently, ^{13}CO-321 was used in this manner for quantitative ^{13}C CP-MAS NMR analysis (including spin counting) of Argonne Premium coals. The cross-polarization time constants, T_{CH}, and the rotating-frame proton spin-lattice relaxation times, $T_{1\rho}^{H}$, were determined for each major peak of each coal via a combination of variable contact-time and variable spin-lock ($T_{1\rho}^{H}$) experiments. Two or three components of rotating-frame ^{1}H relaxation decay and two or three components of T_{CH} behavior were observed for each major ^{13}C peak of each coal. These data were used to determine the number of carbon atoms detected in each coal; these values are in the range between 77% and 87% of the amount of carbon known to be in each coal from elemental analysis data, except for Pocahontas No. 3, for which only 50% of the carbon was detected. In an attempt to use ^{1}H CRAMPS to elucidate chemical functionality in coal, pyridine-saturated samples of the Argonne Premium coals were examined in detail in terms of their ^{1}H CRAMPS NMR spectra. These spectra were deconvoluted to yield relative concentrations for individual peaks.

4902 (DOE/PC/90290–9) **Advanced NMR approaches in the characterization of coal: [Quarterly] report No. 9.** Maciel, G.E. Colorado State Univ., Fort Collins, CO (United States). Dept. of Chemistry. [1992]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-90PC90290. Order Number DE93006010. Source: OSTI; NTIS; GPO Dep.

A considerable effort in this project during the past few months has been focussed on the development of ^{1}H and ^{13}C NMR imaging techniques to yield spatially-resolved chemical shift (structure) information on coal. In order to yield the chemical shift information, a solid-state NMR imaging technique must include magic-angle spinning, so rotating gradient capabilities are indicated. A ^{13}C MAS imaging probe and a ^{1}H MAS imaging probe and the circuitry necessary for rotating gradients have been designed and constructed. The ^{1}H system has already produced promising preliminary results, which are briefly described in this report.

4903 (DOE/PC/91296–4) **Advanced NMR-based techniques for pore structure analysis of coal: Quarterly report No. 3, July 1, 1992–September 30, 1992.** Smith, D.M. New Mexico Univ., Albuquerque, NM (United States). Center for Micro-Engineered Ceramics. [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-91PC91296. Order Number DE93006012. Source: OSTI; NTIS; GPO Dep.

One of the main problems in coal utilization is the inability to properly characterize its complex pore structure. Coals typically have micro/ultra-micro pores but they also exhibit meso and macroporosity. Conventional pore size techniques (adsorption/condensation, mercury porosimetry) are limited because of this broad pore size range, microporosity, reactive nature of coal, samples must be completely dried, and network/percolation effects. Small angle scattering is limited because it probes both open and closed pores. Although one would not expect any single technique to provide a satisfactory description of a coal's structure, it is apparent that better techniques are necessary. We believe that measurement of the NMR parameters of various gas phase and adsorbed phase NMR active probes can provide the resolution to this problem. We now have two suites of well-characterized microporous materials including oxides (zeolites and silica gel) and activated carbons from our industrial partner, Air Products in Allentown, PA. Our current work may be divided into three areas: small-angle X-ray scattering (SAXS), adsorption, and NMR.

4904 (VTT-TIED–1369) **Peat production and utilization for horticultural and chemical purposes in Finland.** Jaervinen, T. (Technical Research Centre of Finland, Espoo (Finland). Combustion and Thermal Engineering Lab.); Haenninen, K. Technical Research Centre of Finland, Espoo (Finland). 1992. 36p. Order Number DE93752865. Source: OSTI; NTIS.

In Finland, approximately one million cubic meters of peat is utilized annually for non-energy purposes. At the moment the main forms of peat use are horticultural and growing purposes. Nearly one half of production has been exported. The utilization of peat for environmental purposes is increasing, and the production of biological active compounds and mixtures also seems to be attractive. Before reaching the actual fuel peat layer a great deal of light, weakly decomposed surface peat has to be removed or produced. This material may be refined for soil improvement and sorbent purposes, litter, and compost. Peat can be processed to produce chemicals in a thermochemical and biochemical manner. There are very many substances, compounds, and materials that can be produced from peat (Allread 1990). In Finland peat coke, fuel, and synthetic gas have been made on an industrial scale. Research and bench-scale development has been carried out since the 1940's by VTT and several universities (Helsinki, Turku, Jyvaeskylae, Joensuu). Thermochemical processes were studied extensively up until the end of last decade. At the moment, interest is focused on studies of peat biochemical and biological conversion processes and on the utilization of the separate fractions and compounds of peat produced with solvent extraction.

0108 Waste Management

Refer also to citation(s) 4847, 4865, 4948, 5372, 5376, 5377, 5378, 5829, 5830

4905 (DOE/PC/91295–T4) **A novel, integrated treatment systems for coal wastewaters: Quarterly Report, June 2, 1992–September 1, 1992.** Wang, H.Y.; Srinivasan, K.R. Michigan Univ., Ann Arbor, MI (United States). Dept. of Chemical Engineering. [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-91PC91295. Order Number DE93004928. Source: OSTI; NTIS; GPO Dep.

The aims of this study are to develop, characterize and optimize a novel treatment scheme that would be effective simultaneously against the toxic organics and heavy metals present in coal conversion wastewaters. Hec-CBDA-DT, a modified hectorite containing a mixed bilayer of a cationic (CBDA) and a diamine (DT) type surfactants, was shown to adsorb simultaneously heavy metals such as Cu^{2+} and Cd^{2+} and toxic organics such as chlorophenols. The pH dependence of the adsorption of chlorophenols on Hec-CBDA-DT suggested hydrophobic partitioning, counterion adsorption and hydrogen-bond interaction of the phenolate ions with the surface diamine groups as the possible mechanisms of sorption. Adsorption of Cu^{2+} by Hec-CBDA-DT was shown to be only slightly affected by a large excess of counterions, thus indicating that Cu^{2+} adsorbed specifically to the surface. A second type of modified clay, Hec-CBDA-Palmitic Acid (Hec-CBDA-PA) adsorbed both Cu^{2+} and Cd^{2+} strongly. However, the pH optima for adsorption were 6.0 and 8.0 respectively in the case of Cu^{2+} and Cd^{2+}. It is inferred that the mechanisms of adsorption of these two metal ions to Hec-CBDA-PA are different, specific and counterion binding respectively in the case of Cu and Cd ions.

4906 (ETDE-mf–93742727) **Development and testing of a method for the storage of fine-grained coal preparation and power station residues in underground goafs. Final report.** Thiehofe, B.; Brocks, U.; Sill, F.; Scheidat, L. Ruhrkohle Niederrhein AG, Duisburg (Germany); Ruhrkohle Westfalen AG, Dortmund (Germany); Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Dec 1991 17p. (In German). Contract BMFT 0326416B. Order Number DE93742727. Source: OSTI; NTIS (US Sales Only).

Synthesis report of two subprojects.

Based on the concepts and examinations of DMT (Bergbau-Forschung) and the preliminary tests at Walsum colliery in the years 1985/86 - FK 03E-6416-A - (BMFT) the general proof concerning the use of the cavities produced by coalmining for the stowage of residues was furnished. By extending the scope of the examinations it was planned to produced the required fundamental information for the planning and construction of an industrial-scale pilot plant. At Walsum colliery hydraulic pipe transport of highly concentrated suspensions using underground mixing and pumping stations as well as trailing pipe technology for goaf filling was examined (sub-project I). At Monopol colliery the mixing, storage and transport technology as well as the transport in the shaft pipeline (approx. 800 m depth) was examined on the surface. Additionally the goaf was filled directly from the surface pumping station. The results of the examinations provided for the planning and construction of a pilot plant at Walsum colliery. The goaf filling method provides for a reasonable utilization of mining and power station residues under mining-related aspects and for an improvement of environmental protection. (orig.).

4907 (SAND–92-1939C) **Initial results from the RHEPP module.** Neau, E.L.; Harjes, H.C.; Reed, K.W.; Penn, K.J.; Wavrik, R.W.; Johnson, D.L.; McClenahan, C.R.; Prestwich, K.R. Sandia National Labs., Albuquerque, NM (United States). [1992]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-920967–2: Advanced research workshop on non-thermal plasma techniques for pollution control, Cambridge (United Kingdom), 21-25 Sep 1992). Order Number DE93004066. Source: OSTI; NTIS; INIS; GPO Dep.

Pulsed discharges can be used to ionize the stack gas to provide the free radicals needed to react chemically with the pollutants. To accomplish this goal over a significant fraction of the volume without heating the bulk of the gas, high voltage, short pulses are applied to the discharge electrodes. These parameters can not be readily achieved with standard pulse generators using thyratrons or hard tubes as switches. Pulse generators based on spark gaps are, planned for the pilot plants but are not likely to have the lifetime required for industrial applications. A technology is required that will provide these >200-kV, <500-ns, 4-M average power pulses and operate reliably for many years without major component replacement. The goal of the Repetitive High Energy Pulsed Power (RHEPP) program is to develop the design techniques, the long life components, and the system architecture that will provide the basis for creating these pulse generators. Our approach is based on the use of saturable reactors in Melville pulse compression networks (Melville 1951). The final L-C stages are arranged as a pulse forming network to produce the required pulse shape. Pulsed electron beams can also be used to ionize stack gases utilizing injected. Our goal during 1993 is to demonstrate the 1-MeV, 160-kW average power, electron-beam accelerator operation and to begin testing of the 2.5-MeV, 350-kW average power, second generation electron beam accelerator. With these accelerators we will establish the reliability of components and systems that could be produced to meet any of the above application requirements. This report describes the approach and progress that we have made towards our goals.

0109 Environmental Aspects

Refer also to citation(s) 4836, 6782

4908 (CONF-9210194–1) **Reduced emissions from inexpensive high-sulphur coal briquettes.** Gammage, R.B. (Oak Ridge National Lab., TN (United States)); Wachter, E.A.; Wade, J.; Wilson, D.L.; Haas, J.W.; Ahmad, N.; Siltain, F.; Raza, M.Z. Oak Ridge National Lab., TN (United States). [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From International symposium on environmental contamination; Budapest (Hungary); 12-16 Oct 1992. Order Number DE93001637. Source: OSTI; NTIS; INIS; GPO Dep.

Airborne emissions were measured during the combustion of Pakistani high-sulphur coal, cold briquetted with lime and clay; comparison was made to emissions from raw coal and traditional fuels burnt in a native, mud-lined Angethi stove. Compared to raw coal, the amended coal gave fourfold reduced emission of respirable-size particles (RSP) and threefold reduced total releases of SO_2. In domestic cooking, substitution of the amended coal briquettes for traditional fuels will not worsen indoor air quality with respect to CO, SO_2, NO_x, and RSP. The high peak amounts of CO (100–250 ppm), SO_2 (2–5 ppm), and NO_x (1–5 ppm) were limited to the early phase of burning. The high thermal value of the coal briquettes together with a simple briquetting technology, make this fuel an attractive energy alternative in countries that are underdeveloped, developing, or experiencing major restructuring.

4909 (DOE/MC/22118–3148) **Field study of disposed wastes from advanced coal processes: Quarterly technical progress report, February 1992–April 1992.** Radian Corp., Austin, TX (United States). [1992]. 73p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-86MC22118. Order Number DE93003987. Source: OSTI; NTIS; GPO Dep.

The Department of Energy/Morgantown Energy Technology Center (DOE/METC) has initiated research on the disposal of solid wastes from advanced coal processes. The objective of this research is to develop information to be used by private industry and government agencies for planning waste disposal practices associated with advanced coal processes. To accomplish this objective, DOE has contracted Radian Corporation and the North Dakota Energy & Environmental Research Center (EERC) to design, construct, and monitor a limited number of field disposal tests with advanced coal process wastes. These field tests will be monitored over a three year period with the emphasis on collecting data on the field disposal of these wastes. There has been considerable research on the characteristics and laboratory leaching behavior of coal wastes – a lesser amount on wastes from advanced coal processes. However, very little information exists on the field disposal behavior of these wastes. Information on field disposal behavior is needed (a) as input to predictive models being developed, (b) as input to the development of rule of thumb design guidelines for the disposal of these wastes, and (c) as evidence of the behavior of these wastes in the natural environment.

0120 Mining

Refer also to citation(s) 4841, 4842, 6593

4910 (ETDE-mf–93750851) **Reduction of hazards and physical stress during manriding underground. Final report.** Muecher, F.; Poetsch, J.; Vollmer, M. Ruhrkohle Westfalen AG, Dortmund (Germany); Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Mar 1992 385p. (In German). Contract BMFT 01HD039. Order Number DE93750851. Source: OSTI; NTIS (US Sales Only).

Under the present research project systematic investigation has been done into the ergonomic and mining engineering aspects of underground manriding. The findings serve to derive appropriate measures for reducing hazards and physical stress. Under the ergonomic section of the research work has been determined the physical stress as a function of environmental conditions and of manriding systems. The methods applied to this end include physiological measurements (ECG, EMG and AEU), somatographic studies, workforce interviews and observation of body postures assumed during work. The engineering aspects cover investigations into underground workings, shafts, main roadways, inclined roadways and gateroads. The hazard potential is defined under due consideration of different RAG accident statistics. As a result of our activities we found that - approx. 35% of underground manriding (mKM/day) is by walking, - approx. 75% of all the manriding accidents happen during walking and, - the specific accident rate (one accident per 10^5 mKM) is lowest for manriding by train and highest for walking. (orig.) With 33 figs.

4911 (OY/PSTL-TIED–83) **Decision making in peat production: Need for a support system. A case.** Karjalainen, T.; Kiukaanniemi, E. Oulu Univ. (Finland). Research Inst. of Northern Finland. 1992. 32p. (In Finnish). Order Number DE93752921. Source: OSTI; NTIS.

According to the research need for information in decision making in peat production is remarkably higher during unstable weather than during fine weather. Simultaneously, information is needed on effects of the rain on producibility of the field during the unstable weather. The experiences from the example working site show that decisions concerning the timing of the start of the production are based on the estimation of production situation made by the contractor. The decision of ridging is usually made on the basis of the weather forecast of the meteorological institute. The weather observations of the contractor and the weather forecasts of the meteorological institute, especially during poor weather, effect on starting of ridging and collection of peat. During the test period in the summer 1991 in Katvansuo mire the forecasted and confirmed evaporation were in good correspondence with each other. In the case of example working site it could be shown that production could have been increased by 7 % by different production planning intensification methods. The drying potential would have required about 20 % higher production. Most of the lack was due to dimensioning of the production capacity. The values of the example working site can, however, not be generalized, but it is obvious that use of support tools such as evaporation and weather forecasts on production sites, and computer based support systems would be reasonable.

4912 (VTT-OPT–41) **Development of ridge drying method and equipment for sod peat.** Erkkilae, A.; Hoelttae, P.; Pirkonen, P. Technical Research Centre of Finland, Jyvaeskylae (Finland). Combustion and Thermal Engineering Lab. 1992. 57p. (In Finnish). Project KTM-52/881/88. Order Number DE93752939. Source: OSTI; NTIS.

OPTIMITURVE Research Programme.

The ridge drying method of sod peat (the Tupla method) was developed in Optimiturve research program during 1988-1990. The increase of seasonal yield using the Tupla method in comparison with Palahaku method was over 70 %. The dry matter loss decreased 10-20 % from the level of losses of traditional methods, which is 30-50 % The production costs decreased by about 10 %. The best seasonal yields were obtained by 55 mm sod. The yield of the tupla method of the production studies made in the Northern Ostrobothnia were 820 MWh/ha in 1989 and 670 MWh/ha in 1990. In addition to the method development, the project also contained equipment development. The equipment dealing with surface sod cutting, the sieving of the ridges and the stockpile sieving were the targets of the research.

4913 (VTT-OPT–45) **Research results of the Optimiturve research program in 1991.** Alakangas, E. (ed.). Technical Research Centre of Finland, Jyvaeskylae (Finland). Combustion and Thermal Engineering Lab. 1992. 69p. (In Finnish). Project KTM-275/881/87. Order Number DE93752849. Source: OSTI; NTIS; INIS.

OPTIMITURVE Research Programme.

Optimiturve research program is one of the energy research programs funded by the Ministry of Trade and Industry of Finland. The main target of the program is double the annual hectare yield of peat dried by solar radiation to decrease the peat production costs, to speed up the circulation of capital invested to peat production with the aid of a new production method developed in this research, and hence improve the price competitivity of peat. The targets of the research program are expected to be completed by improving the drying of peat, the efficiency of the peat production machinery, and by developing peat production techniques. The program was started in 1988, and the targets are to be fulfilled up to year 1993. The research program is carried out in cooperation with universities, research organizations and peat producers. This publication consists of the results of the ongoing projects in the Optimiturve research program in 1991. The aim, the contents and the main results of the 18 projects are presented. At the end of this publication there is a list of the reports published in Reports series.

4914 (VTT-OPT–45, pp. 8-11) **Optimiturve research program in 1991.** Leinonen, A. (Technical Research Centre of Finland, Jyvaeskylae (Finland). Combustion and Thermal Engineering Laboratory). Technical Research Centre of Finland, Jyvaeskylae (Finland). Combustion and Thermal Engineering Lab. 1992. (In Finnish). Project KTM-275/881/87. In *Research results of the Optimiturve research program in 1991.* 69p. Order Number DE93752849. Source: OSTI; NTIS.

OPTIMITURVE Research Programme.

The target of the program is to develop a peat production method, based on solar energy, by which it is possible to double the present annual hectare yield. It has been estimated that if the target of the program can be fulfilled it is possible to decrease the production costs by about 20 %. The target has been strived by intensification of utilization of solar radiation, by improving the collection rate of dry peat, by decreasing the rain effects on production, by lengthening the production season and by decreasing the storage losses. Three new peat production methods have so far been developed in the Optimiturve research program, by which it is possible to obtain the targets of the program. These methods are the new sod peat production method, the ridge drying method and the Multi method.

4915 (VTT-OPT–45, pp. 12-15) **The moisture changes in surface layer of peat and optical measurement of them.** Mannerkoski, H. (Joensuu Univ., Joensuu (Finland). Faculty of Forestry). Technical Research Centre of Finland, Jyvaeskylae (Finland). Combustion and Thermal Engineering Lab. 1992. (In Finnish). Project KTM-275/881/87. In *Research results of the Optimiturve research program in 1991.* 69p. Order Number DE93752849. Source: OSTI; NTIS.

OPTIMITURVE Research Programme.

The solar radiation reaching on the surface of peat is either absorbed into it or reflected from the surface. The absorption of the radiation increases the temperature usually more when the peat is dryer than with wet peat. On the other hand, the energy needed for warming up the peat is higher when the moisture content of the peat is higher. The tests have shown that the reflection of the radiation describes the moisture content of the peat surface quite well. The main target of the research is to determine the radiation reflection from peats of different quality and moisture level, and especially the suitability of reflectance measurements for field utilization. The reflected part of the solar radiation has been measured using four different wave lengths both in controlled conditions and in practice on the milled peat fields using box measurements. Field measurement have been carried out on two production fields. The second target was to determination of water

behaviour in the unsaturated layer above the surface water level. This was endeavoured by measuring the surface water level and the potential energy distribution of the soil water of the upper peat layer using a tensiometer. Additionally, the hydraulic conductivity of saturated peat was measured using a MSU measuring device. The measurement were made in the distances of 2.0, 6.0 and 10.0 m from the center line of the field ditch in 5-10 cm intervals down to depth of 90 cm. On the basis of depth distribution factors of the soil water it has been possible to calculate the potential gradients of the soil water, describing the direction of water flow between tensiometer sited in different depths.

4916 (VTT-OPT–45, pp. 16-19) **Drying model for different main peat types.** Hillebrand, K. (Technical Research Centre of Finland, Jyvaeskylae (Finland). Combustion and Thermal Engineering Laboratory). Technical Research Centre of Finland, Jyvaeskylae (Finland). Combustion and Thermal Engineering Lab. 1992. (In Finnish). Project KTM-275/881/87. In *Research results of the Optimiturve research program in 1991.* 69p. Order Number DE93752849. Source: OSTI; NTIS.

OPTIMITURVE Research Programme.

Forecasting of drying of milled peat layer in varying weather condition is essential for intensification of peat production. The dependence between the drying time of the milled layer and the different factors effecting on it, the drying equation, has to be known in order to the different field and weather conditions into account. Drying models for four main peat types and two humification degrees.

4917 (VTT-OPT–45, pp. 20-21) **Drying models for peat and their applications in the USSR and in Finland.** Leinonen, A. (Technical Research Centre of Finland, Jyvaeskylae (Finland). Combustion and Thermal Engineering Laboratory); Fagan, H. Technical Research Centre of Finland, Jyvaeskylae (Finland). Combustion and Thermal Engineering Lab. 1992. (In Finnish). Project KTM-275/881/87. In *Research results of the Optimiturve research program in 1991.* 69p. Order Number DE93752849. Source: OSTI; NTIS.

OPTIMITURVE Research Programme.

The aim of this research is to construct a mathematical model for peat based on Russian equations for drying of porous materials. The required coefficients are determined experimentally. In the literature survey there is an overview on basic principles of milled and sod peat field drying. The survey deals with theoretical principles, and factors effecting on peat drying. Additionally, the optimal field drying process of peat drying, control of factors effecting on it are also reviewed. Empirical connections derived from drying time calculations and experimental results are illustrated by numerical examples. The determination methods for optimal drying parameters have also been described in the research.

4918 (VTT-OPT–45, pp. 22-24) **Computer and weather and field condition simulation in peat production.** Hillebrand, K. (Technical Research Centre of Finland, Jyvaeskylae (Finland). Combustion and Thermal Engineering Laboratory). Technical Research Centre of Finland, Jyvaeskylae (Finland). Combustion and Thermal Engineering Lab. 1992. (In Finnish). Project KTM-275/881/87. In *Research results of the Optimiturve research program in 1991.* 69p. Order Number DE93752849. Source: OSTI; NTIS.

OPTIMITURVE Research Programme.

The target of the numerical simulation was to determine the optimal production parameters for production in weather and field condition simulator so that the best possible hectare yield could be achieved in prevailing conditions. The best seasonal yield has been obtained in the computerized simulation using milling thickness of 20 mm using total slip of 0-40 %. If the total slip is 50 % or more, equal or slightly larger seasonal yield using 30 mm milling thickness than by using 20 mm milled layer. This means, as the slip increases it is more economical to use 30 mm milling thickness instead of 20 mm. A seasonal yield of 1428 m3/ha was obtained in the weather and field condition simulator. This is 3.7 times higher than actual production on the field. The effect of time required for working phases on hectare yield has been estimated on the basis of computer simulation. On the basis of obtained hectare yields it is possible to calculate that the working phases cause about 25 % decrease on hectare yields. When this is taken into account in calculations, the hectare yield of the weather and field condition simulator is 1071 m3/ha, which is 2.8 times higher than the actual production obtained in the field. As the calculation is made on the base of dry matter yield by assuming that the weight of the peat is 300 kg/m3, the production is 2.6 times higher than the actual production. According to the results it is possible to double the production by using small milling thickness, large particle size, complete collection of the milled layer and timing of the production on the basis of weather conditions.

4919 (VTT-OPT–45, pp. 25-26) **Models for decision making on the contractor and production company levels in peat production.** Kiukaanniemi, E. (Oulu Univ., Oulu (Finland). Research Institute of Northern Finland); Karjalainen, T. Technical Research Centre of Finland, Jyvaeskylae (Finland). Combustion and Thermal Engineering Lab. 1992. (In Finnish). Project KTM-275/881/87. In *Research results of the Optimiturve research program in 1991.* 69p. Order Number DE93752849. Source: OSTI; NTIS.

OPTIMITURVE Research Programme.

The target of this projects was to clarify especially the field based decision making mechanism for production control, and to estimate in which working phases the aid is needed for decision making. The experimental field research results have shown that it is needed especially under unstable weather conditions. On the example working site the weather potential would have presumed 25 % higher output during the test summer. The production would have been intensified by approximately 7 % with the aid of production control. This result, obtained from one test bog, is not generalizeable, but it shows that it is possible to intensify production remarkably by developing the support tools of the decision making.

4920 (VTT-OPT–45, pp. 27-30) **Increasing of the grain size and decreasing of the power demand via research of both active and passive millers.** Leinonen, A. (Technical Research Centre of Finland, Jyvaeskylae (Finland). Combustion and Thermal Engineering Laboratory). Technical Research Centre of Finland, Jyvaeskylae (Finland). Combustion and Thermal Engineering Lab. 1992. (In Finnish). Project KTM-275/881/87. In *Research results of the Optimiturve research program in 1991.* 69p. Order Number DE93752849. Source: OSTI; NTIS.

OPTIMITURVE Research Programme.

The aim of this research has been to grow the grain size of the milled layer from present 5 mm up to 15 mm without increasing the power demand. The average grain size of present screw and spiked millers is 5 mm. The laboratory research with sod peat has shown on the basis of drying, the optimal sod size is 15 mm. No optimal grain size has been determined for milled peat, however, it has been shown that increase of grain size from 5 mm to 10 mm decreases the drying time 10-30 % depending on the peat type. Four different rotating miller cutters, spiked, screw, blade and granulating cutters, were tested in laboratory conditions using two main peat types and two humification degrees. The peats used were medium humified (H4-H6), well humified (H7-H9) Carex peat and Carex-Sphagnum peat. The rotation speed of the miller drum was 450-900 r/min, drawing speed 4.0-5.8 km/h, milling depth 10-20 mm, moisture content of the milling layer 68-76 % and the amount of residual milled layer 0-10 mm. The laboratory tests (about 300), were planned using FPLAN planning program. The results were processed using multi-variant method. Linear mathematical models were created for average grain sizes and power demands of all millers.

4921 (VTT-OPT–45, pp. 31-34) **Research and development of pneumatic harvesting using pneuma-simulator.** Kallio, M. (Technical Research Centre of Finland, Jyvaeskylae (Finland). Combustion and Thermal Engineering Laboratory). Technical Research Centre of Finland, Jyvaeskylae (Finland). Combustion and Thermal Engineering Lab. 1992. (In Finnish). Project KTM-275/881/87. In *Research results of the Optimiturve research program in 1991.* 69p. Order Number DE93752849. Source: OSTI; NTIS.

OPTIMITURVE Research Programme.

The effects of drawing and peat variables in pneumatic harvesting was studied in laboratory using pneumasimulator. The

measuring results were processed for linear polynomial models using multi-variable regression method, which is a part of main component analysis. Graphs were drawn, with the aid of models, to simplify the interpretation of the results. The peats were rather moist (45- 56 %), little or medium humified milled layers containing relatively high amounts of woody obstacles. The nozzles were 80 cm vide Turveruukki type nozzles. They operate best in almost upright position towards the milled layer. The nozzle, the height of the inlet of which is 70 mm collected the peat best. The impurities render operation of the 50 mm nozzles and part of the suction air passes by the milled layer in the case of 80 mm nozzle. The best collection rates (3 kg/s,m) were obtained with 70 mm nozzle using crushed sod peat (56 % moisture content). In the optimum, the drawing speed is slow and the air velocity is high. Corresponding, but a smaller optimum was obtained also by other peat types. Increase of drawing speed decreased linearly the amount of collected peat, and the velocity of air had also a remarkable, obviously linear effect on the amount of collected peat. The best operational range for peat collection seemed to be: drawing speed 3.5-6.5 km/h, and the air velocity over 30 m/s. The power demand of the blower increased as the nozzle was more upright position in respect to the milled layer, because the throttling of the blower decreased. The dust emissions were low, according to the probe measurements well below 1 % of the collected dry matter amount, this due to high moisture content of the peats.

4922 (VTT-OPT–45, pp. 37-39) **Possibilities of air-monitoring in field condition control.** Kiukaanniemi, E. (Oulu Univ., Oulu (Finland). Research Institute of Northern Finland); Tervo, M. Technical Research Centre of Finland, Jyvaeskylae (Finland). Combustion and Thermal Engineering Lab. 1992. (In Finnish). Project KTM-275/881/87. In *Research results of the Optimiturve research program in 1991.* 69p. Order Number DE93752849. Source: OSTI; NTIS.

OPTIMITURVE Research Programme.

The advantages of the aerial photography are the speed and effectiveness in inspection of large areas. It has been utilized in peat production for several autumns to detect self heating of peat stockpiles. The aim of this research was to clarify if the aerial photography is economically and technically viable to be used as a tool for intensification and control of peat production. The basic drying level, the frost level, the condition of ditching, the solid matter emissions and the volume of the stockpiles formed the targets of the research. The results have shown that areas of different surface temperature can be observed by aerial thermography in the surface of a production field. The temperature variation has been noticed to be due to moisture content variation in the areas so that in the day time the driest areas of the bog are warmer, and in nigh time the moistest areas are warmest. Aerial photography, repeated every autumn, it is possible to determine the stockpile volumes, surface height data and the thickness of the remaining peat layer.

4923 (VTT-OPT–45, pp. 43-46) **Measurement of bog water level and the rising of it.** Nyroenen, T. (Vapo Oy, Jyvaeskylae (Finland)). Technical Research Centre of Finland, Jyvaeskylae (Finland). Combustion and Thermal Engineering Lab. 1992. (In Finnish). Project KTM-275/881/87. In *Research results of the Optimiturve research program in 1991.* 69p. Order Number DE93752849. Source: OSTI; NTIS.

OPTIMITURVE Research Programme.

The aim of this research was measurement of rising and the level of the bog water in the peat production field based on relative temperature difference. The measurement is based on the idea that the cooling effect of the bog water in the field is detected by measuring the in depth temperature profile. In this way it is possible to determine the position of the moist (saturated) capillary layer. The bog water wells, tensiometers, bog sensor and both fixed and socket pin adjusted thermometer. Because of the small cooling effect of the bog water the reasonably dense measuring interval is required, e.g. sufficiently low using interval of 5 cm. The greatest temperature difference is formed by the cooling effect of the bog water, due to which the bog water level is near the depth corresponding the T2 temperature. The bog water level obtained from temperature profile measurement was compared with the measurements of the bog water wells. The bog water level determined by the temperature measurement was allowed to be 30 cm above and 10 cm below the well water level, and correspondingly the more stringed approval criterion required that the temperature measurement level was allowed to be only 20 cm above and 10 cm below the well water level. During the molten ground season 77 % of the bog water levels determined on the basis of temperature profile measurements was quite near the well water level on the basis of both selection criteria. The successfulness of the temperature measurements increased by about 80 % even on the basis of the more stringed criterion if the Sphagnum predominant and just piped bog water well areas were leaved out of the inspection.

4924 (VTT-OPT–45, pp. 47-49) **Stump removal in peat production.** Nyroenen, T. (Vapo Oy, Jyvaeskylae (Finland)). Technical Research Centre of Finland, Jyvaeskylae (Finland). Combustion and Thermal Engineering Lab. 1992. (In Finnish). Project KTM-275/881/87. In *Research results of the Optimiturve research program in 1991.* 69p. Order Number DE93752849. Source: OSTI; NTIS.

OPTIMITURVE Research Programme.

The aim of this research was to develop an economical stump removal method for peat production areas, suitable for present tractors. It is possible to improve the quality of deliverable peat by removing the woody matter from production fields. If the wood is milled in the peat, the chips cause troubles for many users. The project consists of development of separate stump loosener and stump loader. The stump loader was developed first. Wood matter loosened using a Russian stumb loosener and smaller wood ridged by a levelling screw was loaded using the developed, continuously operating, tractor driven loader. According to the results a wheel tractor was suitable for utilization as traction engine of the stump loader. The stumb loosener consists of forwards inclined spikes, directed towards the surface of the mire, which are moved forwards and upwards by a n eccentric wheel. The hoisted wood is transferred on the ridge using a screw mounted upside the spikes. A 130 hp wheel tractor was used as traction engine. The operability of the equipment was promising, and the tests are to be continued.

4925 (VTT-OPT–45, pp. 50-52) **Computer based production planning.** Karppimaa, H. (Turveruukki Oy, Oulu (Finland)). Technical Research Centre of Finland, Jyvaeskylae (Finland). Combustion and Thermal Engineering Lab. 1992. (In Finnish). Project KTM-275/881/87. In *Research results of the Optimiturve research program in 1991.* 69p. Order Number DE93752849. Source: OSTI; NTIS.

OPTIMITURVE Research Programme.

The aim of this research was to apply the results of the research programme on actual production in production fields, and to develop a computerized planning program. The research is divided into field research and development of the planning program for production areas. The sub tasks of the field research are: (1) the role of complete collection in milled peat production, (2) drying of production field by cut underdrainage, and (3) ridge drying of milled peat. A software, which can be used for planning of new peat production areas has been developed in the CAD sub-task. It is used for making rough plan alternatives, containing disposition of sectors, roads and stockpiles, and giving of production equipment data. The program calculates different factors, e.g. the average drawing distance, from which it is possible to determine if the stockpiles are correctly located, and are all the strip roads necessary. Calculation can be done for several plans at the same time. The best plan can be chosen for further planning, redesign and cost calculation after the calculation.

4926 (VTT-OPT–45, pp. 53-55) **EKO-900 method.** Nyroenen, T. (Vapo Oy, Jyvaeskylae (Finland)). Technical Research Centre of Finland, Jyvaeskylae (Finland). Combustion and Thermal Engineering Lab. 1992. (In Finnish). Project KTM-275/881/87. In *Research results of the Optimiturve research program in 1991.* 69p. Order Number DE93752849. Source: OSTI; NTIS.

OPTIMITURVE Research Programme.

The target of the research was to develop a peat production chain by which it is possible to obtain the hectare yield 900MWh/a. In addition to this, the second target was to decrease the environmental risks, by improving the fire safety and by reduction of the dust emissions and flushing into ditching. Another important target

of the research was improvement of the peat quality by removing the impurities already in the production, which improves the sorageability of the peat in stockpiles. Tests were made during the summer 1991 using two turning machines equipped with plastic spoons instead of metal ones. The turning machines were constructed so that they could also be used in so called multi ridge method. In EKO 900 method the peat is dried when the weather conditions are suitable. A single harvest is not transported into stockpile, by many harvests are collected into same ridge. The stockpiling is started as the weather conditions became unfavourable for drying. The loaders must then be able to load in the maximum eight harvests at the same time, which can sometimes be half of the annual yield. The optimal amount of harvest in the ridge seems to be six harvests, by which a momental power of 2500 m3/h can be obtained. The basic idea of the sieve constructed into normal Haku unit was removal of wood matter immediately, and collection and removal of surpluses from the field. The constructed sieve operated with almost 100 % accuracy, and the removed wood matter was collected into container sited behind the intake of the loader. The sieve, however, requires further development so it could be relieved and hence easier to use.

4927 (VTT-OPT–45, pp. 56-58) **Utilization of Soviet peat technology.** Karppimaa, H. (Turveruukki Oy, Oulu (Finland)); Hoelttae, P. Technical Research Centre of Finland, Jyvaeskylae (Finland). Combustion and Thermal Engineering Lab. 1992. (In Finnish). Project KTM-275/881/87. In *Research results of the Optimiturve research program in 1991.* 69p. Order Number DE93752849. Source: OSTI; NTIS.

OPTIMITURVE Research Programme.

The aim of this project has been to clear up the operability and parameters of Russian production technology and methods in Finnish conditions under supervision of Russian experts. In the case of sod peat, the aim has been to design and construct bits of 50-60 mm sod size for MTK-16 sod peat cutting machine so, that the original properties remain unchanged. The possibilities for utilization of same bits in the PK-1S or are the bits of the same construction to be constructed separately. A series of tests is made using the new bits in order to define parameters for design of a new sod peat machine. The target of the project in the case of milled peat is to make milling tests using milling machines MTF-19, JR-9 and JR-9K, and to clear up the actual possibilities for maximal production using PPF-6, IPV-30 millers and RAUSSI pneumatic harvester. The parameters to be studied were the maximum efficiency of present machines in production, optimization of working width, activation of the milled layer (recycling of suction air for activation) and affectivity of the separation process.

4928 (VTT-OPT–45, pp. 59-62) **Intensification of sod peat harvesting technology and the effects of it on production costs.** Kallio, E. (Technical Research Centre of Finland, Jyvaeskylae (Finland). Combustion and Thermal Engineering Laboratory). Technical Research Centre of Finland, Jyvaeskylae (Finland). Combustion and Thermal Engineering Lab. 1992. (In Finnish). Project KTM-275/881/87. In *Research results of the Optimiturve research program in 1991.* 69p. Order Number DE93752849. Source: OSTI; NTIS.

OPTIMITURVE Research Programme.

The aim of this research was to study if the sod peat cutting could be improved by using a sod peat machine equipped with own engine, called the power unit, and what are the effects of it on sod peat production costs, and to clarify the production costs through the whole production chain from harvesting to stockpile. Research was carried out on production fields in Kankaanpaeae and Kauhajoki. The small ridge method was chosen to be used as sod peat production method, so same production method, excluding the sod cutting, was in use at both production fields. The tractor-PALA S-1 combination was used in Kankaanpaeae, and tractor-PALA S-2 combination in Kauhajoki. The aim of the research was the production: the load of the field, losses, amount of the stockpiled peat, the working and machine time used for different working phases, and fuel consumption. Drying of sod peat and the weather conditions were also detected. The production costs were calculated using production cost calculation software, developed by the Technical Research Centre of Finland (VTT). The formation of production costs of different cost factors, the cutting costs of different cutting alternatives, and the effects of different production parameters: the losses, the area of the production field and the amount of heater yield on production costs, have been researched.

4929 (VTT-OPT–45, pp. 63-65) **Sod peat based multiple peat production method.** Karppimaa, H. (Turveruukki Oy, Oulu (Finland)); Erkkilae, A. Technical Research Centre of Finland, Jyvaeskylae (Finland). Combustion and Thermal Engineering Lab. 1992. (In Finnish). Project KTM-275/881/87. In *Research results of the Optimiturve research program in 1991.* 69p. Order Number DE93752849. Source: OSTI; NTIS.

OPTIMITURVE Research Programme.

The aim of this project was to develop a production method, by which it is possible to utilize the total production area and the fines, formed in different production phases, remaining on the field in present production methods. The method is based on sod peat production by ridge drying method, on utilization of fines formed in the method, and on peat production using milled peat or corresponding method on the free area. The long-term target of the project is to optimize the sod/milled peat machines and production for different types of mires so that the production would be profitable while using both methods, and the utilization of peat, produced using both methods, in power and processing plants would be taken into account in production planning. At present there are power plants that can use both sod and milled peat. The target for 1991 has been to produce peat corresponding to the hectare yield of the Optimiturve research program using the basic version of Multi method, and to compare the results with those of the ridge drying method of sod peat production methods (Tupla, Palahaku methods) and the milled peat production method (Haku). Additionally, the Multi method was developed further via special experiments. The targets of the Optimiturve research program were obtained in the production tests of 1991 if compared with the results of the Haku milled peat production method (300 MWh/ha).

4930 (VTT-OPT–45, pp. 66-67) **Optimization of milled peat storage.** Nyroenen, T. (Vapo Oy, Jyvaeskylae (Finland)). Technical Research Centre of Finland, Jyvaeskylae (Finland). Combustion and Thermal Engineering Lab. 1992. (In Finnish). Project KTM-275/881/87. In *Research results of the Optimiturve research program in 1991.* 69p. Order Number DE93752849. Source: OSTI; NTIS.

OPTIMITURVE Research Programme.

The aim of this research was to define the scale of milled peat storages both nationally and regionally taking the consumption forecasts into account. Another target was to optimize the location of individual stockpiles and the location of stockpiles on the production site taking the used production technology, length of storaging period and the stockpiling technology into account. The operative and strategic sizes of storages are obtained as results of the research. Additionally, the siting of stockpiles can be estimated even in the case of non-field ditched alternative. The technical details of stockpiling were checked first, and they were corrected to meet the present situation taking the size of the stockpile and the preservability into account. After this the size and location of the stockpiles were detected using the LP model. The idea of this model is the transversed transportation model, in which the best mires and storages are sought on the basis of the needs of the customer. The transportation distances and the quality information are taken into account in the next stage. Finally, the optimal sites and the amounts of storages are sought. The planned determinations and modelling have been done, and the model has been tested using two peat consumption sites and four production sites. The testing will be carried out further.

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Refer also to citation(s) 4837, 4846, 4853, 4854, 4862, 4863, 4875, 4883, 5345, 5804, 5860, 6252

4931 (ANL/CMT/CP–77193) **Measurement of alkali in PFBC exhaust.** Lee, S.H.D.; Swift, W.M. Argonne National Lab., IL (United States). [1992]. 9p. Sponsored by USDOE, Washington, DC

(United States). DOE Contract W-31109-ENG-38. (CONF-921034–1: US Department of Energy contractors review meeting on coal-fueled heat engines, advanced PFBC and gas stream cleanup systems, Morgantown, WV (United States), 27-28 Oct 1992). Order Number DE93002900. Source: OSTI; NTIS; GPO Dep.

This project supports the DOE/METC Fossil Energy Program for the development of PFBC technology. Based on the analytical activated-bauxite sorber-bed technique, we are developing the RABSAM as an alternative to the on-line alkali analyzer for field application. As shown in Fig. 1, the RABSAM is a sampling probe containing a regenerable activated-bauxite adsorbent (RABA). It can be inserted directly into the PFBC exhaust duct and requires no HTHP sampling line. Alkali vapors are captured by the adsorbent purely through physical adsorption. The adsorbent is regenerated by a simple water-leaching process, which also recovers the adsorbed alkalis. The alkali analysis of the leachate by atomic absorption (AA) provides a basis for calculating the time-averaged alkali-vapor concentration in the PFBC exhaust. If the RABA is to use commercial grade activated bauxite, the clay impurities in activated bauxite can react with alkali vapors and, therefore, need to be either removed or deactivated. In earlier work, a 6M-LiCl-solution impregnation technique was shown to deactivate these impurities in fresh activated bauxite [8]. During this year, RABA prepared by this technique was tested in a pressurized alkali-vapor sorption test unit to determine its NaCl-vapor capture efficiency and the regenerability of the sorbent by water extraction. Results of this study are presented and discussed.

4932 (ANL/CP–76799) **Selection of non-adsorbing alkali components.** Lee, S.H.D.; Natesan, K.; Swift, W.M. Argonne National Lab., IL (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (DOE/NBM–93000210;CONF-920951–46: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93002995. Source: OSTI; NTIS; GPO Dep.

This project consists of three phases of laboratory experimental study. In phase I (screening), eight candidate materials, 304SS (serves as a base material for comparison), Hastelloy C-276, Hastelloy X, Haynes No. 188, Allonized 304SS, Pt-coated 304SS, and ceramic-coated 304SS, will be subjected to atmospheric TGA study under the simulated PFBC (oxidizing) environment with and without alkali vapor doping. Each candidate material will be evaluated for its resistance toward alkali-vapor capture. In addition, a post-test metallographic characterization of the sample will be performed to obtain a better understanding of the alkali capture mechanism and material behavior. The material(s) with little or no alkali-vapor adsorption will be selected as the promising material(s) for the Phase II study. In Phase II, the promising material(s) will be further tested in the TGA under elevated pressure to simulate the PFBC environment (in terms of temperature, pressure, and gas composition). The effect of pressure on the extent of alkali-vapor adsorption will be evaluated, and the test samples will be metallographically characterized. The most promising candidate material(s) will be identified and recommended for further tesfing in the actual PFBC environment. In Phase III, four materials will be selected from the eight candidate materials screened in the PFBC environment and will be evaluated for their alkali-vapor capture by atmospheric TGA under the coal gasification fuel gas (reducing) environment. The tested samples will also be metallographically characterized. The most promising material(s) will be identified and recommended for further testing in the actual coal gasification environment.

4933 (ANL/CP–77469) **Computer modeling of fluidized-beds.** Bouillard, J.X.; Lyczkowski, R.W.; Ding, J. Argonne National Lab., IL (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9209160–22: International symposium on energy, environment and information management, Argonne, IL (United States), 15-18 Sep 1992). Order Number DE93003002. Source: OSTI; NTIS; GPO Dep.

Bubbling fluidized-bed combustors are being built as a means of burning high-sulfur coals in an environmentally acceptable manner. Although this technology has reached a commercial status, understanding of solids motion and its effect on erosion of heat exchanger tubes immersed in fluidized beds remains inadequate. To understand the mechanics of solids motion in fluidized beds with internal heat exchangers, a two-dimensional fluidized bed is simulated using hydrodynamic models. Predicted instantaneous and time-averaged porosities at different locations in the bed are compared with experimentally measured values. Power spectral analyses of both computed and experimental transient porosities are made to validate the presently used hydrodynamic model of fluidization. This study further extends the validation of such models used in earlier studies to compare experimental and predicted bubble sizes.

4934 (CHEC–9103) **Nitrous oxide formation and destruction in fluidized bed combustion: A literature review of kinetics.** Johnsson, J.E. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Inst. for Kemiteknik. Nov 1991. 31p. (CONF-9111283–1: 23. IEA-AFBC-meeting, Firenze (Italy), 8 Nov 1991). Order Number DE93752996. Source: OSTI; NTIS.

Recent literature on the subject of nitrous oxide emission has been reviewed with emphasis on the kinetics necessasry to model the N_2O formation and destruction at conditions relevant for fluidized bed combustion. An increase in combustion temperature, air staging and increased volatile content in the fuel decreased the emission of N_2O, NH_3 injection and increased excess air has the opposite effect. The addition of limestone was found to either decrease the N_2O emission or have no influence. The conclusion of this work is that the disagreement may be due to different catalytic activity for different types of limestone for the catalytic decomposition of N_2O. The formation and destruction of N_2O by homogeneous gas phase reactions was investigated experimentally and by modelling using comprehensive chemical kinetic models. The conclusion is that HNC is an important precursour for the N_2O formation. The decomposition of N_2O via reactions with H and OH is fast. The most important routes for N_2O formation by heterogeneous reactions are oxidation of char-nitrogen, catalytic reduction of NO and catalytic oxidation of NH_3. The fraction of char-N conversion to N_2O has been found to vary between 1 and 10% during char combustion. Calcined limestone and char are the most important catalysts for heterogeneous decomposition of N_2O, but the activity depends on the type of limestone and char. For both materials there are two orders of magnetude between the rate constants for the most and the least active types. A reaction scheme is set up. A simplified calculation example for N_2O decompostion in a circulating fluidized bed combustor indicates that both homogeneous and heterogeneous reactions may be important. (AB) (36 refs.).

4935 (CHEC–9104) **An evaluation of drying and devolatilization in the IEA-AFBC model - and a new model proposal.** Jensen, A. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Inst. for Kemiteknik. Nov 1991. 25p. (CONF-9111283–1: 23. IEA-AFBC-meeting, Firenze (Italy), 8 Nov 1991). Order Number DE93752993. Source: OSTI; NTIS.

Devolatilization of coal particles is a complex phenomenon involving both heat and mass transfer coupled to chemical kinetics. Since volatiles may contain up to about 50% of the total energy released during combustion, it is important to know where the volatiles are released. If the volatiles are released directly into the freeboard, f.ex when over bed feeding is used, the freeboard must be designed to give the gased sufficient residence time for burnout to occur. The purpose of this paper is to give an evaluation of the treatment of drying and devolatilization in the IEA-AFBC model. A new model, taking internal temperature gradients into account is proposed and compared to the existing model. The distribution of moisture and volatiles is based on a comparison of the time scales for drying and devolatilization to take place and the turnover time. The turnover time describes the vertical mixing rate of solids in the bed. The distribution of volatiles is calculation in subroutine VSPLIT. It is not the scope of this paper to evaluate the model for the distribution of moisture and volatiles, which is used in its present form. (AB).

4936 (CHEC–9105) **A preliminary kinetic model for NO_x formation and reduction in PFBC.** Johnsson, J.E. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Inst. for Kemiteknik. Nov 1991. 30p. Order Number DE93752995. Source: OSTI; NTIS.

A model for the formation and reduction of NO_x in fluidized-bed combustion must contain information about: Volatile nitrogen release, formation of NO_x from char combustion, volatile nitrogen conversion, and reduction of NO_x. A schematic kinetic model for the reactions is given. This scheme will be used as a framework for the model. At first a systematic model for the formation and reduction of NO_x will be set up, i.e. a model for volatile nitrogen conversion and NO_x reduction. However, the model is set up in a general formulation and more reactions and catalysts can be included when kinetic information becomes available. The kinetics are valid for atmospheric pressure, and may change at higher pressures. (AB).

4937 (CHEC–9106) **Heating of coal particles in fluidized bed combustion.** Jensen, A. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Inst. for Kemiteknik. Nov 1991. 22p. Order Number DE93752994. Source: OSTI; NTIS.

In order to improve the performance of coal fired furnaces, a better understanding of coal devolatilization is very much of interest. The process is complex, coupling heat transport and mass transport to the kinetics of the decomposition reactions. A complete description of the process with respect to composition and evolution rate of individual volatiles is presently not possible. The present paper provides a short discussion of the transport mechanisms involved in devolatilization, i.e heat and mass transport. Furthermore, predicted heating times of coal particles using simple models are presented. (au) (12 refs.).

4938 (CONF-921104–10) **Evaluation of control of fluidization quality through chaotic time series analysis of pressure-drop measurements.** Daw, C.S. (Oak Ridge National Lab., TN (United States)); Halow, J.S. Oak Ridge National Lab., TN (United States). [1992]. 39p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From American Institute of Chemical Engineers annual meeting; Miami, FL (United States); 1-6 Nov 1992. Order Number DE93004174. Source: OSTI; NTIS; GPO Dep.

Recent applications of chaotic time series analysis to pressure-drop and voidage measurements from gas-fluidized beds have demonstrated that such data exhibit many of the signature characteristics of deterministic chaos. Research is now being sponsored by the US Department of Energy to determine if knowledge and control of chaotic structure in fluidized beds can be used to improve the performance of fossil energy conversion processes using fluidized beds. In this paper we discuss the use of chaotic time series analysis for evaluating fluidization quality. In particular, we show that certain chaotic features in pressure-drop measurements can be used to determine the type of fluidization (e.g., slugging, smoothly bubbling, turbulent) both locally and globally in the bed. We also suggest examples of how this information can be used for implementing closed-loop control of fluidized-bed hydrodynamics.

4939 (DOE/MC/21023–93/C0086) **Second-generation PFBC systems research and development.** Robertson, A.; Van Hook, J.; Carli, G.; Crooker, P.; Froehlich, S.; Kahrs, S.; Kulcsar, D.; Lu, C.; Malenboym, P.; Torpey, M. Foster Wheeler Development Corp., Livingston, NJ (United States). [1992]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-86MC21023. (CONF-920951–19: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93002615. Source: OSTI; NTIS; GPO Dep.

Three major objectives of Phase 2 are: Separately test key components [the carbonizer, circulating pressurized fluidized bed combustor (CPFBC), cross-flow filter, and topping combustor] of second-generation PFB combustion plants at laboratory scale to ascertain their performance characteristics. Revise the commercial plant performance and economic predictions where necessary. Prepare for a 1.6-MWe equivalent Phase 3 integrated subsystem test of the key components. The carbonizer test program has been very successful. It has demonstrated that carbonizer operation is smooth and controlled, emissions are lower than were previously estimated for a commercial plant, and the char/sorbent residue and fuel gas from the process appear compatible with particle-capturing ceramic barrier filters.

4940 (DOE/MC/25137–3104) **Demonstration Program performance test summary reports.** Colorado-Ute Electric Association, Inc., Montrose, CO (United States). Mar 1992. 451p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC21-89MC25137. Order Number DE92001299. Source: OSTI; NTIS; GPO Dep.

This volume contains the performance test summary reports generated by the Colorado-Ute Electric Association's Nucla Circulating Fluidized Bed Demonstration Program. These summary reports supplement the performance test results presented in the Demonstration Project Final Technical Report and the Annual Technical Progress Reports. The Phase I test program began in February 1987 and was completed in June 1990. This segment was jointly sponsored by the United States Department of Energy (DOE) and the Electric Power Research Institute (EPRI). The Phase II test program commenced in October 1991 following a DOE extension agreement, and was completed in January 1991 with sole sponsorship by the DOE. The objectives of these programs were to conduct a cost-shared Clean Coal Technology Project to demonstrate the feasibility of circulating fluidized bed combustion technology and to evaluate the economic, environmental, and operational benefits of CFB steam generators on a utility scale. These tests established the effects of load, excess air, primary to secondary air ratio, unit operating temperatures, coal and limestone feed configurations, and coal type and size distributions on emissions performance and combustion and boiler efficiencies. Data were also collected from these tests to quantify heat transfer in the combustion chambers, tubular air heater effectiveness, and baghouse collection efficiency. Dynamic response and unit start-up data were collected to determine any CFB technology limitations and to optimize unit performance.

4941 (DOE/MC/25137–3127) **Economic evaluation report.** Colorado-Ute Electric Association, Inc., Montrose, CO (United States). Mar 1992. 436p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC21-89MC25137. Order Number DE93000212. Source: OSTI; NTIS; INIS; GPO Dep.

The objective of this report is to establish a database of costs associated with operating a circulating fluidized bed boiler for electric power production in a utility environment. Such data and information can be used by others for resource planning and for comparisons with competing technologies. Costs are also presented for the engineering, construction and start-up of the Nucla CFB. These are compared with estimates made in 1981 prior to completing detailed engineering. Detailed monthly operating costs over the testing period covered by the Cooperative Agreement, from September 1988 through January 1991, are presented in Appendix D. An overall summary of cost data for this period is presented in the same format in Appendix C. These data were generated by CUEA using reporting requirements established by the Rural Electrification Administration's Uniform System of Accounts. This accounting system is consistent with that used by the Federal Energy Regulatory Commission's Uniform System of Accounts, which is prescribed for public utilities and licensees subject to the provisions of the Federal Power Act. The definitions of terms used in the REA code of accounts are contained in Appendix B.

4942 (DOE/MC/27364–93/C0078) **Pilot plant test results and demonstration of the Ahlstrom Pyroflow pressurized CFB technology.** Provol, S.J. (Pyropower Corp., San Diego, CA (United States)); Dryden, R.J. Iowa Power, Inc., Des Moines, IA (United States); Pyropower Corp., San Diego, CA (United States). [1992]. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC21-91MC27364. (CONF-9209201–3: Application of fluidized-bed combustion for power generation utility conference, Boston, MA (United States), 23-25 Sep 1992). Order Number DE93002219. Source: OSTI; NTIS; GPO Dep.

Ahlstrom Pyropower initiated development of PCFB technology in 1086 after a detailed analysis of competing advanced coal utilization technologies. A 10 MWth pilot plant was started up in 1989 and has produced very promising test results which are highly competitive with coal gasification. This led to a successful application for demonstration of the technology under round III of the DOE Clean Coal Technology Program. The resulting project is Iowa

Power's DMEC-1 PCFB Repowering Project. The project is currently in the preliminary engineering phase with supporting pilot plant testing being performed in parallel. Successful demonstration of PCFB technology will provide utilities with a cost effective option for repowering older power stations to comply with the requirements of the 1990 Clean Air Act Amendment in the near term and a clean and high efficiency new plant option in the longer term. This paper will present recent pilot plant test results and review the major technical features of the DMEC-1 project.

4943 (DOE/METC/C–93/7039) **Capacitance imaging system for monitoring bubble formation and flow in fluid bed simulators.** Paton, D.E.; Fasching, G.E.; Smith, N.S. Jr. USDOE Morgantown Energy Technology Center, WV (United States). [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). (CONF-920799–3: Review of progress in quantitative non destructive evaluation (NDE), La Jolla, CA (United States), 19-24 Jul 1992). Order Number DE93002396. Source: OSTI; NTIS; GPO Dep.

The CIS is providing researchers with unique, detailed information on the flow patterns (both solids and voids) within a cold fluid bed simulator. Researchers at METC plan tests during the fall of 92 using the 4-level, 193-pixel CIS to study flow patterns in a 30.4-cm diameter fluid bed simulator. For improved resolution the system could be converted to a 545-pixel, 8-level, 32-electrode system. This technology is applicable for multi-component flows where the components display significant differences in dielectric constants. Potential applications of this technology include measurement of high density particle flow streams and characterization of material flow/mixing patterns in commercial processes such as catalytic crackers.

4944 (DOE/METC/C–93/7045) **Particle collection efficiency of a cyclonic combustor.** Romero, C.E. (Oak Ridge Associated Universities, Inc., TN (United States)); Shaw, D.W.; Ontko, J.S. USDOE Morgantown Energy Technology Center, WV (United States). [1992]. 14p. Sponsored by USDOE, Washington, DC (United States). (CONF-921034–4: US Department of Energy contractors review meeting on coal-fueled heat engines, advanced PFBC and gas stream cleanup systems, Morgantown, WV (United States), 27-28 Oct 1992). Order Number DE93003198. Source: OSTI; NTIS; GPO Dep.

As a preliminary design study for the Combined Combustion and Cleanup Concept (4-C) Combustor, particulate capture performance was assessed by means of cold flow model testing. The goals of this effort were to: Determine the relevant parameters for particle retention (also known as grade efficiency); develop a scaling law to extrapolate cold flow data to combustion conditions; obtain experimental data to develop a workable grade efficiency correlation; assess the adequacy of the correlation. The 4-C Combustor, is an effort to combine high combustion efficiency with enhanced environmental performance in a pressurized combustor for direct coal-fired gas turbine applications. The fuel is burned in an outer annular region, in a zone bounded by the outer radius of the annulus and the radius of the collection cone where it is held in suspension by a balance of centrifugal forces on the fuel particles and drag induced by secondary combustion air. After burning, the ash particles cross into a central cyclonic section, where they are removed from the gas stream and collected in a hopper at the bottom of the conical section. The cleaned gas exits the combustor through a vertical tube.

4945 (DOE/METC/C–93/7049) **NO_x formation in unsteady combustion.** Norton, T.S. (USDOE Morgantown Energy Technology Center, WV (United States)); Richards, G.A.; Narayanaswami, L.L. USDOE Morgantown Energy Technology Center, WV (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). (CONF-921034–5: US Department of Energy contractors review meeting on coal-fueled heat engines, advanced PFBC and gas stream cleanup systems, Morgantown, WV (United States), 27-28 Oct 1992). Order Number DE93003481. Source: OSTI; NTIS; GPO Dep.

It has been found that fuel-lean operating conditions produce the best results for the current aerovalve pulse combustor. Under these conditions, the levels of unburned hydrocarbon pollutants in the exhaust stream are negligibly low. Initial results on CO indicate that the gas chromatograph method (thermal conductivity detector) is not sensitive enough to measure concentrations below 500 ppM. The modeling work involves the modification of an existing Thermal Pulse Combustor code to include some detailed chemistry. Two methods are used. In the first method, a kinetic mechanism for the formation of thermal NO is superimposed onto the oscillating field of temperature and pressure predicted by the existing pulse combustor model. The concentrations of oxygen atoms and N_2, which control the NO formation step, are estimated from an equilibrium calculation at each temperature and pressure condition. Then the NO formation rate is determined from the rate of the reaction $N_2 + 0 \rightarrow NO + N$. In the second method, more detailed chemistry is incorporated into the base model and the chemical heat release equations are used to drive the pulsations instead of vice versa. The 0-atom concentration is determined from a complex series of chain reactions, rather than by equilibrium.

4946 (DOE/NBM–93000207) **In situ real-time species analysis of particulates and deposits.** Ottesen, D.K.; Hardesty, D.R. Sandia National Labs., Livermore, CA (United States). [1992]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DR00789. (CONF-920951–35: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93000207. Source: OSTI; NTIS; GPO Dep.

We have used LASS to determine the elemental composition of materials in a variety of physical states (bulk, surface deposits, particulates, gases). A small volume of the material (typically 100 μm in diameter by a few micrometers in depth for solids) is rapidly vaporized using a high-energy pulsed laser. A high temperature plasma is formed, and time-resolved atomic emission spectroscopy is used to determine the elemental composition. LASS is a particularly attractive diagnostic for these applications due to its (1) true in situ nature which does not require sample extraction or handling; (2) sensitivity to inorganic species, particularly metals; (3) simultaneous multielement detection; and (4) rapid measurement times and high signal/noise ratios in high temperature particle-laden environments. Work is divided into three tasks: (1) initial development and calibration of LASS and FTIR instrumentation for the analysis of elemental and chemical species in surface deposits; (2) validation of LASS and FTIR instrumentation for the analysis of complex deposits in Fossil Energy process flows; and (3) the design, fabrication and testing of a prototype mobile LASS system. During FY92 work in the project has been devoted primarily to the first task.

4947 (DOE/PC/79796–T29) **Enhancing the use of coals by gas reburning-sorbent injection: Quarterly report No. 20, July 1–September 30, 1992.** Energy and Environmental Research Corp., Irvine, CA (United States). 15 Oct 1992. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-87PC79796. Order Number DE93004945. Source: OSTI; NTIS; GPO Dep.

The objective of this project is to evaluate and demonstrate a cost effective emission control technology for acid rain precursors, oxides of nitrogen (NO_x) and sulfur (SO_x) on two coal fired utility boilers in Illinois. The units selected are representative of pre-NSPS design practices: tangential and cyclone fired. Work on a third unit, wall fired, has been stopped because of funding limitations. The specific objectives are to demonstrate reductions of 60 percent in NO_x and 50 percent in SO_x emissions, by a combination of two developed technologies, gas reburning (GR) and sorbent injection (SI). With GR, about 80–85 percent of the coal fuel is fired in the primary combustion zone. The balance of the fuel is added downstream as natural gas to create a slightly fuel rich environment in which NO_x is converted to N_2. The combustion process is completed by overfire air addition. So_x emissions are reduced by injecting dry sorbents (usually calcium based) into the upper furnace. The sorbents trap SO_x as solid sulfates that are collected in the particulate control device. This project is conducted in three phases at each site: (1) Design and Permitting; (2) Construction and Startup; and, (3) Operation, Data Collection, Reporting and Disposition. Technology transfer to industry is accomplished through the formation of an industry panel.

4948 (DOE/PC/89659–T10) **Coal reburning for cyclone boiler NO_x control demonstration: Quarterly report No. 9, April, May, and June 1992.** Babcock and Wilcox Co., Cassville, WI (United States). [1992]. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-90PC89659. Order Number DE93004941. Source: OSTI; NTIS; GPO Dep.

The Coal Reburning for cyclone Boiler No. Control Demonstration project progress for April, May, and June 1992 is identified in this ninth quarterly report and pertains to the on-going activities of Phase III – Construction and Start-up and Phase III – Operation and Disposition. The project involves retrofitting/testing the reburning technology at Wisconsin Power & Light's 100 MWe Nelson Dewey Unit No. 2 in Cassville, Wisconsin to determine the commercial applicability of this technology to reduce NO_x emission levels. Under Phase IIB additional tuning of the control system was completed and operation in the full automatic mode was carried out in May, 1992 in anticipation of long-term testing. Phase IIB was complete at that point. Phase III activities emphasized completion of parametric optimization testing to characterize the reburn system. As of May 21, 1992, long-term testing with WP&L operating the reburn system in full automatic in a load following mode, was under way. Preliminary results indicate that No. emissions reductions of 50% and greater have been achieved as a result of reburn operation at full load. Furnace exit gas temperature has been reduced by 150°F as a result of reburn operation, again at full load. This effect is less significant at lower loads. No adverse impact on slagging and fouling has been observed and precipitator performance remains essentially unchanged. Unburned carbon on ash losses appear to have increased during reburn operation. Preliminarily at full load, boiler thermal efficiency is reduced because of higher unburned carbon by between 0.3% and 0.7% in the worst case. Efficiency losses appear to be higher at low loads. This effect will be further quantified with long-term performance test data to be taken in September, 1992.

4949 (DOE/PC/90038–T2) **Synthesis of a naphthalene-hydroxynaphthalene polymer model compound: Quarterly report No. 4, March 13, 1991–June 12, 1991.** Kwong, C.D. Southern Research Inst., Birmingham, AL (United States). 22 Jul 1991. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-90PC90038. Order Number DE93006127. Source: OSTI; NTIS; GPO Dep.

The objective of this project is the synthesis of a new naphthalene-hydroxynaphthalene polymer model compound for use in coal combustion studies. Since this compound is an unreported compound, this effort also requires the development of a synthetic route to this compound, including the synthesis of unreported intermediates leading to its synthesis. Complex product mixtures have been consistently obtained with all of our approaches. As a result, we have been constantly making small modifications to our technical approach. These changes are discussed in this report. Our synthesis efforts resulted in a number of potential precursors and intermediates. When appropriate, these compounds were submitted to the Organic Chemistry Research Area's Analytical Section for characterization and identification.

4950 (DOE/PC/90038–T3) **Synthesis of a naphthalene-hydroxynaphthalene polymer model compound: Quarterly report, June 13, 1990–September 12, 1990.** Kwong, C.D. Southern Research Inst., Birmingham, AL (United States). 9 Oct 1990. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-90PC90038. Order Number DE93006128. Source: OSTI; NTIS; GPO Dep.

This goal is to synthesize a new naphthalene hydroxynaphthalene polymer model compound for use in coal combustion studies. na effort will also require the development of a synthetic procedure to synthesize this compound since it is unreported. As a result of our synthesis efforts, a number of potential precursors and Area's Analytical Section for characterization and identification. The synthesis of the pre-Bakefite intermediate has been identified as being key to the evaluation of our synthetic approach to the target compound. During this quarter, we have been reevaluating our synthetic approach while we have begun trying to synthesize this compound. As a result of our reevaluation, we also have been considering slightly modified target compounds which might be obtained by more direct routes or from commercially available materials. We also targeted simplified intermediates which would expedite our evaluation of the feasibility of the Bakelite process for the final polymerization, the key step of our suggested scheme. The results of our simplified model compound will also provide data to help us determine any modifications that will be required.

4951 (DOE/PC/90038–T4) **Synthesis of a naphthalene-hydroxynaphthalene polymer model compound: Quarterly report, September 13, 1990–December 12, 1990.** Kwong, C.D. Southern Research Inst., Birmingham, AL (United States). 15 Jan 1991. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-90PC90038. Order Number DE93006129. Source: OSTI; NTIS; GPO Dep.

The goal is to synthesize a new naphthalene-hydroxynaphthalene polymer model compound for use in coal combustion studies. This effort will also require the development of a synthetic procedure to synthesize this compound since it is unreported. Our synthesis efforts have resulted in the preparation of a number of potential precursors and intermediates. These compounds were submitted to the Organic Chemistry Research Area's Analytical Section for characterization and identification. The synthesis of the pre-Bakelite intermediate has continued to be the focus of our efforts. We first modified the target intermediate slightly to allow this compound to be obtained by a more direct route, using commercially available materials. Since then, we have further simplified intermediate to expedite our evaluation of the feasibility of the Bakelite process for the final polymerization, the key step of our suggested scheme.

4952 (DOE/PC/90038–T5) **Synthesis of a naphthalene-hydroxynaphthalene polymer model compound: Quarterly report, December 13, 1990–March 12, 1991.** Kwong, C.D. Southern Research Inst., Birmingham, AL (United States). 15 Apr 1991. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-90PC90038. Order Number DE93006130. Source: OSTI; NTIS; GPO Dep.

The objective of this contract is the synthesis of a new naphthalene-hydroxynaphthalene polymer model compound for coal combustion studies. This effort also requires the development of a synthetic procedure for this compound since it has not been reported before. We can only report that we are still unable to provide the target polymer or even any of the key intermediates leading to this target Dr. Rao has been informed of our progress (or lack of progress), and he has suggested that we begin to design other alternative compounds which contain the functionalities required by the target compound. In response to this suggestion, we have quickly designed the potential targets shown in Scheme VIL We are currently evaluating the schemes further and we will continue designing routes to the other analogous compounds.

4953 (DOE/PC/90169–T7) **Coal desulfurization in a rotary kiln combustor: Final report, March 15, 1990–July 31, 1991.** Cobb, J.T. Jr. BCR National Lab., Pittsburgh, PA (United States). 11 Sep 1992. 77p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-90PC90169. (BCRNL-L–1665). Order Number DE93005086. Source: OSTI; NTIS; GPO Dep.

The purpose of this project was to demonstrate the combustion of coal and coal wastes in a rotary kiln reactor with limestone addition for sulfur control. The rationale for the project was the perception that rotary systems could bring several advantages to combustion of these fuels, and may thus offer an alternative to fluid-bed boilers. Towards this end, an existing wood pyrolysis kiln (the Humphrey Charcoal kiln) was to be suitably refurbished and retrofitted with a specially designed version of a patented air distributor provided by Universal Energy, Inc. (UEI). As the project progressed beyond the initial stages, a number of issues were raised regarding the feasibility and the possible advantages of burning coals in a rotary kiln combustor and, in particular, the suitability of the Humphrey Charcoal kiln as a combustor. Instead, an opportunity arose to conduct combustion tests in the PEDCO Rotary Cascading-Bed Boiler (RCBB) commercial demonstration unit at the North American Rayon CO. (NARCO) in Elizabethton, TN. The tests focused on anthracite culm and had two objectives: (a) determine the feasibility of burning anthracite culms in a rotary kiln boiler and (b) obtain input for any further work involving the Humphrey Charcoal kiln combustor. A number of tests were conducted at the PEDCO unit.

The last one was conducted on anthracite culm procured directly from the feed bin of a commercial circulating fluid-bed boiler. The results were disappointing; it was difficult to maintain sustained combustion even when large quantities of supplemental fuel were used. Combustion efficiency was poor, around 60 percent. The results suggest that the rotary kiln boiler, as designed, is ill-suited with respect to low-grade, hard to burn solid fuels, such as anthracite culm. Indeed, data from combustion of bituminous coal in the PEDCO unit suggest that with respect to coal in general, the rotary kiln boiler appears inferior to the circulating fluid bed boiler.

4954 (DOE/PC/90363–T6) **Development of advanced NO_x control concepts for coal-fired utility boilers: Quarterly technical progress report no. 6, January 1, 1992–March 31, 1992.** Evans, A.; Pont, J.N.; England, G.; Seeker, W.R. Energy and Environmental Research Corp., Irvine, CA (United States). 15 Sep 1992. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-90PC90363. Order Number DE93004360. Source: OSTI; NTIS; GPO Dep.

All three of the CombiNO_x NO_x control technologies were performed simultaneously for the first time. Tests were performed while firing coal as the primary fuel, and natural gas and coal as reburn fuels. The results for the complete CombiNO_x process for coal firing and natural gas reburning are displayed in Figure 3-1. NO/NO_x measurements were taken with the new sample system. The filter and line were cleaned periodically throughout testing to avoid ash build-up; ash has also been shown to convert NO_2 to NO. Reduction due to natural gas reburning was 54% with burnout air injected at a downstream location of approximately 1600°F. Advanced Gas Reburning produced a 79% reduction – although it is suspected that better reduction would have been possible if injection resolution in the furnace allowed the urea to be injected at a more optimum temperature of 1850°F. The methanol injection step converted 45% of the existing NO to NO_2, achieving an overall CombiNO_x NO reduction of 89%. The coal reburning CombiNO_x test results are displayed in Figure 3-2. Results are similar to those obtained for natural gas reburning. Reduction due to urea injection was better while reburning with coal than for natural gas, probably due to the more optimum urea injection temperature. The methanol injection step converted 40% of the NO to NO_2, similar to the 45% NO conversion that occurred for natural gas reburning. An overall CombiNO_x NO reduction of 93% was achieved, resulting in a final NO concentration of 61 ppM at 3% O_2.

4955 (DOE/PC/91161–T2) **A coal-fired combustion system for industrial process heating applications: Quarterly technical progress report, April 1992–June 1992.** Vortec Corp., Collegeville, PA (United States). 3 Sep 1992. 37p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-91PC91161. Order Number DE93005987. Source: OSTI; NTIS; GPO Dep.

PETC has implemented a number of advanced combustion research projects that will lead to the establishment of a broad, commercially acceptable engineering data base for the advancement of coal as the fuel of choice for boilers, furnaces, and process heaters. Vortec Corporation's Phase III development contract DE-AC22-91PC91161 for a "Coal-Fired Combustion System for Industrial Process Heating Applications" is project funded under the DOE/PETC advanced combustion program. This advanced combustion system research program is for the development of innovative coal-fired process heaters which can be used for high temperature melting, smelling and waste vitrification processes. The process heater concepts to be developed are based on advanced glass melting and ore smelting furnaces developed and patented by Vortec Corporation. The process heater systems to be developed have multiple use applications; however, the Phase III research effort is being focused on the development of a process heater system to be used for producing value added vitrified glass products from boiler/incinerator ashes and industrial wastes. The primary objective of the Phase III project is to develop and integrate all the system components, from fuel through total system controls, and then test the complete system in order to evaluate its potential marketability. During the current reporting period, approval of Vortec's Environmental Assessment (EA) required under the National Environmental Policy Act (NEPA) was approved. The EA approval cycle took approximately 9 months. The preliminary test program which was being held in abeyance pending approval of the EA was initiated. Six preliminary test runs were successfully competed during the period. Engineering and design activities in support of the Phase III proof of concept are continuing, and modifications to the existing test system configuration to allow performance of the preliminary tests were completed.

4956 (DOE/PC/91292–T4) **Rheological properties essential for the atomization of coal water slurries (CWS): Quarterly progress report, June 15, 1992–September 15, 1992.** Ohene, F. Grambling State Univ., LA (United States). Dept. of Chemistry. [1992]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-91PC91292. Order Number DE93006004. Source: OSTI; NTIS; GPO Dep.

The overall objective of this project is to perform experiments to understand the effect of high shear and extensional properties on the atomization of coal-water slurries (CWS). In the atomization studies, the mean drop size of the CWS sprays will be determined at various air-to CWS. A correlation between the extensional and high shear properties, particle size distributions and the atomization will be made in order to determine the influence of these parameters on the atomization of CWS. During the past quarter, several experimental studies on pressure dependent atomization of Coal-water slurries and simulated fluids were performed. Also surface tension, elastic, high and low shear viscosities were performed. These tests were performed to initiate the understanding of the fundamental parameters that govern the atomization process of CWS.

4957 (ECN-RX–92-035) **Mineral matter behaviour in low-NOx combustion: A laboratory study.** Ten Brink, H.M.; Eenkhoorn, S.; Hamburg, G. Netherlands Energy Research Foundation (ECN), Petten (Netherlands). Jul 1992. 23p. Order Number DE93752678. Source: OSTI; NTIS (US Sales Only).

Paper presented at the EPRI conference on the Effects of Coal Quality on Power Plants, San Diego, California, USA, 25-27 August 1992.

A bench-scale facility was built for the representative testing of the behaviour of coal minerals in low-NOx (staged) combustion of pulverized coal. The heart of the system is a staged laminar-flow gas burner with a primary central fuel-rich burner, surrounded by an oxygen-rich secondary burner. Refractory plates are used to test the deposition behaviour of the coal minerals in the near-burner zone. The form of the ash resulting from the minerals was also assessed. Bituminous coals were used, one rich in pyrite and one rich in calcite, both slag inducing minerals. A silica-rich coal was primarily tested for the form of the fly ash. Close to the burner the unburnt coal forms a protective layer on the probe surface, preventing deposition of the minerals. At greater distances the secondary air burns away this carbon layer so that the minerals can reach the probe. The calcite breaks up into fragments which are too small to impact. The pyrite particles gave a tenacious slag since they deposit and stick in molten form and solidify by oxidation. It is thus concluded that it is in the combustion air rather than the primary flow that gives rise to burner slagging with pyrite. More specific guidelines for slag prevention will come from a future model that will use the test data obtained here combined with the proper burner-aerodynamics. It is concluded from the present work that it is not the difference in oxygen environment that causes the observed differences in form between fly ash from staged and unstaged boilers. Fine silica dust, which gives a reflective deposit in boilers, is a relic of the fine silica included in the coal. These inclusions do not agglomerate because of the high melting point and are liberated from the coal char at carbon burnt-out when the char disintegrates. Staging does not influence this process. 3 figs., 2 tabs., 13 refs.

4958 (NEI-DK–981) **Nordic seminar on combustion and gasification reactivities of solid fuels.** Risoe National Lab., Roskilde (Denmark); Nordisk Ministerraad. 1992. 154p. (CONF-9208192–: Nordic seminar on combustion and gasification reactivities of solid fuels, Roskilde (Denmark), 19-20 Aug 1992). Order Number DE93752783. Source: OSTI; NTIS.

The aim of the Nordic Energy Research Programme is to strengthen the basic competence in the energy field at universities and research organizations. Combustion reactivity of various solid

fuels was selected by the solid fuel committee as an important topic for cooperation. A model fuel (coke particles) was chosen and distributed to different laboratories for performing experiments with quite different experimental techniques. The resulting activities were then calculated by use of one model. The partial aim of the seminar was to discuss various possible models and modelling assumptions and to compare the same experimental results calculated by use of different models. Gasification reactivities were also discussed, in addition to carbon burnout processes. (AB).

4959 (NEI-DK–981 [1-12]) **Reactivity measurements of coke particles in five different flow reactors.** Hustad, J.E. (SINTEF, Trondheim (Norway)); Aho, M.J.; Hupa, M.; Noopila, T.; Soerensen, L.H.; Clausen, S.; Kioerboe, L.; Gromulski, J.; Bengtsson, M.; Leckner, B. Risoe National Lab., Roskilde (Denmark); Nordisk Ministerraad. 1992. (CONF-9208192–: Nordic seminar on combustion and gasification reactivities of solid fuels, Roskilde (Denmark), 19-20 Aug 1992). In *Nordic seminar on combustion and gasification reactivities of solid fuels.* 154p. Order Number DE93752783. Source: OSTI; NTIS.

A comparative study on carbon particle reactivity has been initiated through the Nordic Council of Ministers' Energy Research Programme, Committee on Solid Fuel Combustion. Experiments on reactivity of 128 μm coke particles in the gas temperature range from 1150 K to 1370 K have been performed in five different flow reactors in the Nordic countries and all the results were calculated by the shrinking particle model. The agreement between the results of the various techniques is within a factor of 1.5 above or below the median level. The activation energy is found to be 25 kval/mol indicating combustion control by the combined effects of chemical kinetic and pore diffusion (zone II combustion). The overall apparent reaction order was found to be 1.0. (au) (12 refs.).

4960 (NEI-DK–981 [1-14]) **Combustion reactivity of coke particles using VTT-model.** Saastamoinen, J. (VTT, Combustion and Thermal Engineering Laboratory, Jyvaeskylae (Finland)). Risoe National Lab., Roskilde (Denmark); Nordisk Ministerraad. 1992. (CONF-9208192–: Nordic seminar on combustion and gasification reactivities of solid fuels, Roskilde (Denmark), 19-20 Aug 1992). In *Nordic seminar on combustion and gasification reactivities of solid fuels.* 154p. Order Number DE93752783. Source: OSTI; NTIS.

The simple case of mere char combustion with shirking core model is considered in relation to combustion reactivity of coke particles. The calculation results are presented in the form of tables followed by conclusion. (AB).

4961 (NEI-DK–981 [1-12]) **Combustion reactivity of coke particles using Risoe-model.** Holst Soerensen, L. (Department of Combustion Research, Risoe National Laboratory, Roskilde (Denmark)); Gjernes, E. Risoe National Lab., Roskilde (Denmark); Nordisk Ministerraad. 1992. (CONF-9208192–: Nordic seminar on combustion and gasification reactivities of solid fuels, Roskilde (Denmark), 19-20 Aug 1992). In *Nordic seminar on combustion and gasification reactivities of solid fuels.* 154p. Order Number DE93752783. Source: OSTI; NTIS.

Experiments on reactivity of 128μm, coke particles have been performed in the gas temperature range from 1150K to 1370K in five different reactors in the Nordic countries. The results have been calculated by a 'shrinking core model'. The results from the model developed at Risoe are compared with calculated results from VTT and NTH. The results has once earlier been modelled by the involved laboratories, but with more detailed informations on the experimental conditions a better approach was possible. To compare the results most important was the neglection of the flow-field that thus reduced to be represented purely by the slip mass- and heat transfer to the particle. Second it had some effect that preheatment of particles was included as required for the interpretation for part of the experiments. These effects are largest for larger particles. Much less scatter was obtained in the data and good log K_s /1/T plot was obtained. (au).

4962 (NEI-DK–981 [1-9]) **Comparison of results between VTT, Risoe and NTH: Model calculations based on the same experimental results.** Soerensen, L.H.; Saastamoinen, J.; Hustad, J.E. Risoe National Lab., Roskilde (Denmark); Nordisk Ministerraad. 1992. (CONF-9208192–: Nordic seminar on combustion and gasification reactivities of solid fuels, Roskilde (Denmark), 19-20 Aug 1992). In *Nordic seminar on combustion and gasification reactivities of solid fuels.* 154p. Order Number DE93752783. Source: OSTI; NTIS.

In the three previous presentations, the NTH-, VTT- and the RISOe-model have been presented. All three models claim that they are shrinking core models which means that all chemical reactions are lumped to the outer surface of the particle giving a decreasing particle diameter as a function of burn off, the density of the particle is, however, kept constant. The aim of this comparison is to see if we get the same results based on the same input parameters to the models. The theoretical equations and assumptions are described in the previous presentations and only the results and a preliminary conclusion will be focused on in this presentation. (au).

4963 (NEI-DK–981 [1-14]) **Biomass char reactivity with steam.** Espenaes, B.-G. (TPS, Studsvik, Nykoeping (Sweden)). Risoe National Lab., Roskilde (Denmark); Nordisk Ministerraad. 1992. (CONF-9208192–: Nordic seminar on combustion and gasification reactivities of solid fuels, Roskilde (Denmark), 19-20 Aug 1992). In *Nordic seminar on combustion and gasification reactivities of solid fuels.* 154p. Order Number DE93752783. Source: OSTI; NTIS.

A wide range of reactivities, using steam as oxidizer, have been observed for biomass chars of different origin. Reaction rates of tested straw fuels differ by a factor of about 25, which corresponds to a temperature difference of 130 deg. C. Investigated fuels include wood, straw and peat. Influences of different pressures during char formation (pyrolysis) from vacuum to 1 MPa, different tar contents in the gas environment and different heating rates are shown. A high reactivity of the char is favoured by process conditons where the volatiles are rapidly removed from the char. The reactivity of highly reactive char is reduced by freshly formed pyrolysis gas and this effect can be seen through all the course of conversion. Moisture content of the fuel in fast pyrolysis increases the reactivity. Peat chars, seem to consist of two types of materials which typically show different dependence upon reactor conditions. The reaction rate of a more reactive part of the peat char is dependent upon the pressure during its formation and also on the steam pressure during gasification, while the low-reactive part is insensitive to these variations of reactor conditions. The effect from demineralization of a peat char suggests that behaviours are related to catalytic effects. Influences of elevated pressure of steam-nitrogen on the reaction rates of chars from wood and peat are also shown. Reaction rates in steam-nitrogen mixtures were measured by TGA at steam partial pressures from 0.073 to 2.2 MPa. Some recent results with gas mixtures containing product gases at ambient and elevated pressures are also presented. The product gases hydrogen and carbon monoxide have prenounced inhibiting effects on the reaction rate, especially at high total pressures. (au).

4964 (NEI-DK–981 [1-15]) **A microscopic method for studying reaction mechanisms in char gasification.** Moilanen, A. (Technical Research Centre of Finland (VTT), Laboratory of Fuel and Process Technology, Espoo (Finland)); Saviharju, K. Risoe National Lab., Roskilde (Denmark); Nordisk Ministerraad. 1992. (CONF-9208192–: Nordic seminar on combustion and gasification reactivities of solid fuels, Roskilde (Denmark), 19-20 Aug 1992). In *Nordic seminar on combustion and gasification reactivities of solid fuels.* 154p. Order Number DE93752783. Source: OSTI; NTIS.

The objective was to obtain data on the gasification reaction mechanisms taking place in char particles. Granulated sod peat char, particle diameter 1-3 mm, was gasified in diluted air with an oxygen content of 0.5 vol-%. Isothermal reactivity measurements were performed at temperatures 400-650 deg. C. The effect of gasification reactions on char microscopic structure was observed as darkening of the originally highly light-reflecting char. The reflectograms of the samples gasified to 50% conversion at temperatures of 400, 415, and 425 deg. C had a relatively symmetrical Gaussian shape with one maximum. The particles had darkened throughout. Regarding the reflectograms of the samples gasified at higher temperatures, between 450 and 650 deg. C, the maximum at higher reflectance values increased with the temperature compared to that at lower reflectance values, a less-reacted core. The

size of this higher reflecting core compared to that of reacted parts of char increases with the temperature. Light reflection profiles measured across the char particles indicate the actual magnitudes of the unreacted and reacted parts as a function of particle diameter. Reflectance profile measurements and reflectograms compared with the Arrhenius plot drawn from the mass change curves, gave information about the controlling mechanism of the reactivity. The method developed gives information about the actual reaction processes during the gasification of biomass chars, and about fragmentation processes taking place in a fluid-bed reactor. (AB) (14 refs.).

4965 (NEI-DK–981 [1-9]) **Experiments on carbon burnout at pressurized conditions.** Jalovaara, J. (Helsinki University of Technology, Espoo (Finland)); Ruottu, A.; Lu, Y.; Jahkola, A. Risoe National Lab., Roskilde (Denmark); Nordisk Ministerraad. 1992. (CONF-9208192–: Nordic seminar on combustion and gasification reactivities of solid fuels, Roskilde (Denmark), 19-20 Aug 1992). In *Nordic seminar on combustion and gasification reactivities of solid fuels.* 154p. Order Number DE93752783. Source: OSTI; NTIS.

The combustion properties of five different fuels (one peat, one brown coal and three bituminous coals) have been recently studied at the small batch-scale pressurized fluidized bed reactor of Helsinki University of Technology. The reactor tube, which is 78 mm in diameter, is electrically heated. Pressure levels were chosen 6, 10 and 14 bar and bed temperature was kept at 820 deg. C. Fluidizing gas was a mixture of 6% oxygen and 94% nitrogen. The particle size of used fuels was between 1.6 and 2.0 mm and the weight of fuel batches was exactly 1.0 g. Natural silica sand was used as bed material. The combustion experiments of fuel particles showed that pressure and also fuel type have a remarkable influence on the volatile and char burnout in a fluidized bed. It was noticed that the burning rates of volatiles and char of all fuels increased about 25% (and burnout times of volatiles and char decreased) when pressure changed from 6 to 14 bar. However, further experiments will be needed in the future to get a better understanding of the influence of pressure on combustion process of a single fuel particle in fluidized bed conditions. (au).

4966 (RISO-R–613) **Department of combustion research. Annual progress report 1 Januar - 31 December 1991.** Rathmann, O.; Larsen, E. (eds.). Risoe National Lab., Roskilde (Denmark). Combustion Dept. Jun 1992. 40p. Order Number DE93752740. Source: OSTI; NTIS.

The main activities in the Department of Combustion Research are surveyed in this Progress Report covering the period from 1 January to 31 December 1991. Facilities and equipment are mentioned briefly. The activities are divided into the following groups: combustion chemistry/fuel reactivity, atmospheric combustion systems; biomass combustion and gasification, pressurized combustion/gasification, oil/natural gas, and other activities. (au) (1 tab., 24 ills., 12 refs.).

0150 Economic, Industrial, and Business Aspects

Refer also to citation(s) 4913, 4914, 4928

4967 (DOE/EIA–0121(92/2Q)) **Quarterly coal report, April–June 1992.** USDOE Energy Information Administration, Washington, DC (United States). Office of Coal, Nuclear, Electric and Alternate Fuels. 24 Nov 1992. 162p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93003983. Source: OSTI; NTIS; GPO Dep.

The Quarterly Coal Report (QCR) provides comprehensive information about US coal production, distribution, exports, imports, receipts, prices, consumption, and stocks to a wide audience, including Congress, Federal and State agencies, the coal industry, and the general public. Coke production, consumption, distribution, imports, and exports data are also provided. The data presented in this report are collected and published by the Energy Information Administration (EIA) to fulfill data collection and dissemination responsibilities as specified in the Federal Energy Administration Act of 1974 (Public Law 93-275), as amended. This issue presents detailed quarterly data for April through June 1992 and aggregated quarterly historical data for 1984 through the second quarter of 1992. Appendix A displays, from 1980 on, detailed quarterly historical coal imports data, as specified in Section 202 of the Energy Policy and Conservation Amendments Act of 1985 (Public Law 99-58). Appendix B gives selected quarterly tables converted to metric tons. To provide a complete picture of coal supply and demand in the United States, historical information has been integrated in this report.

0160 Health and Safety

Refer also to citation(s) 6720

4968 (ETDE/NL-mf–93752684) **Biological effects of air pollution resulting from the combustion of coal.** Booij, M. (Nederlandse Maatschappij voor Energie en Milieu BV (NOVEM), Utrecht (Netherlands)); Vink, G.J. Nederlandse Maatschappij voor Energie en Milieu BV (NOVEM), Utrecht (Netherlands). Jan 1990 27p. Order Number DE93752684. Source: OSTI; NTIS (US Sales Only).

A brief account of work, carried out within the framework of the Effects Programme of the Dutch National Coal Research Programme is given. Each chapter deals with a particular project or cluster of related projects. The information is based on summaries of a large number of research reports written by participating institutes. The titles of the chapters are, apart from the title of this record: Toxic properties in vitro of fly ash and stack ash from various coal-burning installations; Effects of respirable fly ash in 'in vitro' and in inhalation studies; Long-term effects on soil and vegetation caused by emissions of trace elements; and Effects of flue gas from a coal-fired boiler on plants. It can be stated that there is now a clearly improved understanding of the nature and, to a lesser extent, the magnitude of biological effects as a result of the burning of coal. Definite pointers have been provided concerning the way in which the combustion of coal should take place. However, since coal flue gas contains a wide variety of organic and inorganic components, it is not possible to establish air quality criteria for its specific components. 1 fig., 7 ills., 4 tabs., 35 refs.

02 PETROLEUM

Refer also to citation(s) 5713

4969 (NEI-NO–293) **Advanced Petroleum Conference 1991.** Norsk Petroleumsforening, Oslo (Norway). 1991 193p. (CONF-911143–: 5. international offshore Northern Seas advanced petroleum conference: exploration and development strategies in mature areas, Stavanger (Norway), 19-20 Nov 1991). Order Number DE93752946. Source: OSTI; NTIS.

Separate abstracts were prepared for 4 papers of this conference.

4970 (NEI-NO–293 A10 1-21) **Future trends in development solutions.** Enger, T. (Norsk Hydro A/S (Norway)). Norsk Petroleumsforening, Oslo (Norway). 1991. 193p. (CONF-911143–: 5. international offshore Northern Seas advanced petroleum conference: exploration and development strategies in mature areas, Stavanger (Norway), 19-20 Nov 1991). In *Advanced Petroleum Conference 1991.* Order Number DE93752946. Source: OSTI; NTIS.

Tremendous achievements have been made in the developments of oil and gas fields in the North Sea. The combination of prolific hydrocarbon reservoirs and harsh environmental conditions has provided great incentives for technological improvements in many aspects of offshore field development and production. The North Sea, and the Norwegian continental shelf (NCS) in particular, has been the area where most advances in offshore exploitation have taken place over the last 20 years. It is difficult to predict whether this will also be the case over the next 20 years. The challenges facing the North Sea in the future will certainly be quite different from what they have been in the past. The North Sea is becoming a more mature area and infrastructure has been developed in most areas where discoveries have been made. One of the greatest challenges facing the Authorities and the Industry is certainly to utilize this infrastructure in the most efficient way.

4971 (NUTEK-ALTD–92-4) **The life of fuels. Motor fuels from source to end use: An energy and emissions systems study of conventional and future options.** Ekelund, M. (Ecotraffic AB, Stockholm (Sweden)); Johansson, A.; Brandberg, Aa.; Roth, A. Swedish National Board for Industrial and Technical Development (NUTEK), Stockholm (Sweden). Mar 1992. 193p. Project NUTEK-266-129. Order Number DE93753019. Source: OSTI; NTIS.

The purpose of this study is to explore energy utilization, emissions and environmental impact, touching somewhat on health aspects, relative to the full energy chain for automotive fuels, from the primary energy source up to and including the end use in road vehicles. The scope of the study comprises also to clarify methodology used for energy and emission accounts, and to elaborate the way of presenting the fairly complex results. The fuels dealt with are diesel oil (low sulphur standard and urban), gasoline (standard lead free and reformulated), propane (LPG), methane in the form of natural gas and biogas (lucerne) respectively, methanol from natural gas and from biomass (energy forest and tree residues), ethanol from biomass (wheat, energy forest and tree residues), vegetable oil methyl ester from rapeseed (RME), hydrogen (electrolysis of water), and electricity (Swedish average generation and natural gas based).

0202 Reserves, Geology, and Exploration

Refer also to citation(s) 4966, 4978, 4992

4972 (NEI-NO–293 A4 1-17) **Status and future challenges on the Norwegian continental shelf.** Nystad, A.N. (Oljedirektoratet, Stavanger (Norway)). Norsk Petroleumsforening, Oslo (Norway). 1991. 193p. (CONF-911143–: 5. international offshore Northern Seas advanced petroleum conference: exploration and development strategies in mature areas, Stavanger (Norway), 19-20 Nov 1991). In *Advanced Petroleum Conference 1991*. Order Number DE93752946. Source: OSTI; NTIS.

The economic productivity of the Norwegian Continental Shelf is high due to high success-ratio in combination with the hydrocarbon volumes and high production rate from each production well. Based on last year's production level, the remaining proven resources together with our estimates of improved oil recovery give us a resource to production rate of approximately 40 years for oil and 200 years for gas. This is in itself a rather comfortable time span for planning purposes. The total area on the Norwegian Continental Shelf with sedimentary rocks is approximately 1.1 million km^2. So far the acreage opened up and available for exploration in the North Sea, Mid Norway and in the Barents Sea is approximately 435,000 km^2 or 40% of the total area. The acreage not yet available for exploration is approximately 650,000 km^2. There are major areas for future exploration both in the North Sea, Mid Norway as well as in the Barents Sea. The remaining areas in Mid Norway that are not opened are in the same order of magnitude as all opened areas in the North Sea and Mid Norway together. The remaining areas in the Barents Sea that are not opened, are in the same order of magnitude as all opened areas on the whole Norwegian Continental Shelf.

4973 (NEI-NO–293 A5 1-18) **Technological/economic strategies for exploration in mature areas.** Bjerke, L.T. (Saga Petroleum A/S (Norway)). Norsk Petroleumsforening, Oslo (Norway). 1991. 193p. (CONF-911143–: 5. international offshore Northern Seas advanced petroleum conference: exploration and development strategies in mature areas, Stavanger (Norway), 19-20 Nov 1991). In *Advanced Petroleum Conference 1991*. Order Number DE93752946. Source: OSTI; NTIS.

Characteristics of a mature exploration area include the discovery of generally smaller fields, a lower discovery rate and hence an increasing finding cost per barrel of oil. The North Sea infrastructure system offers an incentive for increased exploration drilling. A huge seismic and well database can ensure a high discovery success if and when data become available. Improved processing and interpretation of exploration data will reduce the number of misplaced wells and will with increased drilling efficiency keep discovery costs down. Better integration of geology, geophysics, reservoir and drilling engineering must be achieved. The timing of production from satellite discoveries is critical for their economy. In the coming decade exploration for such fields will be attractive in mature areas where production will be starting to decline. 13 figs.

4974 (NEI-NO–303) **Geodynamic basin models: development of the intracratonic Skagerrak basin and the Voering volcanic margin.** Pedersen, T. Oslo Univ. (Norway). May 1992. 196p. Order Number DE93753000. Source: OSTI; NTIS.

The thesis consists of nine individual papers which have been published (5), are in press (3) or submitted to international journals (1). The first three papers discuss the evolution of the intracratonic Skagerrak Basin comprising the offshore part of the Late Paleozoic Oslo Rift. A geodynamic model is developed including lithospheric extension, metamorphism of magmatic rocks emplaced on crustal levels and rheology. Deep seismic (16 s two way time) reflection data reveal the presence of crustal structures approximately 1000 My old. The lithospheric profile shows reflections down to 100 km depth. Papers 4-7 concern the Voering Volcanic Margin off mid-Norway. A positive asthenospheric temperature anomaly of 50-80°C is found sufficient to account for the huge magmatism which occurred during continental break-up. Rifting commenced about 75 My and the established lithospheric relief was infilled by hot material from the proto-Iceland plume established beneath Greenland at about 62 My. The last two papers (8-9) deal with new methods for estimating heat flow when rifting occurs above a hot asthenosphere, and the effect on the amount and composition of magma generated by decompression melting when syntectonic conductive and adiabatic cooling are accounted for.

4975 (NEI-NO–304) **An investigation into the factors influencing tar-mat formation in petroleum reservoirs.** Wilhelms, A. Oslo Univ. (Norway). 1992. 343p. Order Number DE93753012. Source: OSTI; NTIS.

The main aim of the present thesis is to investigate the processes and mechanisms leading to tar-mat formation in petroleum reservoirs. Fields being investigated are: The geochemistry of asphaltenes relating to tar-mat occurrence in petroleum reservoirs; nitrogen functionality distributions in asphaltenes isolated from several oils from different source rock types; characterization of asphaltenes by pyrolysis-field ionization mass spectrometry; relationships between normal and isoprenoid alkyl groups in asphaltenes and associated crude oil alkanes - indications from gas-chromotography isotope ratio mass spectrometry; on the origin of tar-mats in petroleum reservoirs - introduction and case-studies and formation mechanisms for tar-mats; recognition and quantification of the effects of primary migration in a Jurassic clastic source-rock from the Norwegian continental shelf; influence of bitumen-2 on Rock-Eval pyrolysis. 36 refs., 68 figs., 38 tabs.

4976 (SI–910125-3) **Compact representation of seismic sections.** Daehlen, M.; Hjelle, Oe. Senter for Industriforskning, Oslo (Norway). Apr 1992. 22p. Order Number DE93752945. Source: OSTI; NTIS.

A new method for the compression of seismic sections based on a surface decomposition strategy is presented. In the decomposition process a function representing the seismic section is rewritten into a sequence of functions whose sum gives an approximation to the original data set. Data compression is obtained by keeping only the coefficient from the components that give a significant contribution to the reconstruction. By significant we shall mean that the distance between the original seismic section and the reconstruction is less than a predefined tolerance in some convenient norm. Experiments show that satisfactory interpretation quality is readily obtained with storage requirements in the range of 1 to 2 bits per sample. 10 refs., 4 figs.

0203 Drilling and Production

Refer also to citation(s) 5011, 5742, 6153

4977 (CONF-920383–3) **Deep heavy oil recovery by steam injection using twin horizontal drainholes.** Cooper, G.A. (California Univ., Berkeley, CA (United States)); Zeyrek, M.S.; Gondouin, M. S-Cal Research Corp., San Rafael, CA (United States). [1992]. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG01-92CE15553. From Western regional meeting of the Society of Petroleum Engineers (SPE); Bakersfield,

CA (United States); 30 Mar - 1 apr 1992. Order Number DE93002456. Source: OSTI; NTIS; INIS; GPO Dep.

We propose a novel method for improving the efficiency of recovery of heavy oil. Two horizontal drainholes are made at the bottom of a vertical well so that one may be steamed while the other is in production. Downgoing steam and rising produced fluids are carried in the same vertical casing so that heat from the produced fluids reduces heat losses from the steam. This arrangement requires a downhole valve that will switch steam and produced fluids between the boreholes. We discuss the design of a suitable well and of the valves, and report results of tests to select suitable materials to function in the high temperature downhole environment.

4978 (DOE/BC–91/4) **Contracts for field projects and supporting research on enhanced oil recovery: Progress review No. 68, quarter ending September 30, 1991.** USDOE Assistant Secretary for Fossil Energy, Washington, DC (United States). Office of Oil, Gas and Shale Technology; USDOE Bartlesville Project Office, OK (United States). Nov 1992. 173p. Sponsored by USDOE, Washington, DC (United States). Order Number DE92001052. Source: OSTI; NTIS; GPO Dep.

Progress reports are presented for the following tasks: chemical flooding-supporting research; gas displacement-supporting research; thermal recovery-supporting research; geoscience technology; resource assessment technology; and microbial technology. A list of available publications is also included.

4979 (ETDE-mf–93744304) **Development of separators for reliable offshore demixing of oil/gas multiphase flows. Final report.** Pastuch, J. JAFO Technologie, Hamburg (Germany); Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Dec 1991 138p. (In German). Contract BMFT 0326676D. Order Number DE93744304. Source: OSTI; NTIS (US Sales Only).

The report describes investigations on the separation characteristics of multiphase mixtures occurring in enhanced recovery. The investigations were carried out in the course of an interlaboratory research project on multiphase transport technology (MTT). The experiments were to determine the applicability of three-phase separators, so-called hydrocyclones. The main interest was on the liquid/liquid system oil/water, with heating oil or hydraulic oil and tap water as model substances. Further multiphase mixtures were simulated using sieved quartz sand as solid material and nitrogen as gaseous material. The separation characteristics were tested for the two-phase mixture oil/water and the three-phase mixtures oil/water/solid and oil/water/gas. (orig.).

4980 (NIPER–611) **CT imaging of enhanced oil recovery experiments.** Gall, B.L. National Inst. for Petroleum and Energy Research, Bartlesville, OK (United States). Dec 1992. 29p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-83FE60149. Order Number DE93000103. Source: OSTI; NTIS; GPO Dep.

X-ray computerized tomography (Cr) has been used to study fluid distributions during chemical enhanced oil recovery experiments. Four CT-monitored corefloods were conducted, and oil saturation distributions were calculated at various stages of the experiments. Results suggested that this technique could add significant information toward interpretation and evaluation of surfactant/polymer EOR recovery methods. CT-monitored tracer tests provided information about flow properties in the core samples. Nonuniform fluid advance could be observed, even in core that appeared uniform by visual inspection. Porosity distribution maps based on CT density calculations also showed the presence of different porosity layers that affected fluid movement through the cores. Several types of CT-monitored corefloods were conducted. Comparisons were made for CT-monitored corefloods using chemical systems that were highly successful in reducing residual oil saturations in laboratory experiments and less successful systems. Changes were made in surfactant formulation and in concentration of the mobility control polymer. Use of a poor mobility control agent failed to move oil that was not initially displaced by the injected surfactant solution; even when a "good" surfactant system was used. Use of a less favorable surfactant system with adequate mobility control could produce as much oil as the use of a good surfactant system with inadequate mobility control. The role of mobility control, therefore, becomes a critical parameter for successful application of chemical EOR. Continuation of efforts to use CT imaging in connection with chemical EOR evaluations is recommended.

4981 (NIPER–629) **Modeling and laboratory investigations of microbial oil recovery mechanisms in porous media.** Chang, M.M.; Bryant, R.S.; Stepp, A.K.; Bertus, K.M. National Inst. for Petroleum and Energy Research, Bartlesville, OK (United States). Dec 1992. 31p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-83FE60149. Order Number DE93000105. Source: OSTI; NTIS; GPO Dep.

Simulation and experimental results on the transport of microbes and nutrients in one-dimensional cores are presented, and the development of a three-dimensional, three-phase, multiple-component numerical model to describe the microbial transport and oil recovery in porous media is described. The change of rock's wettability and associated relative permeability values after microbial treatments were accounted for in the model for additional oil recovery. Porosity and permeability reductions due to cell clogging have been considered and the production of gas by microbial metabolism has been incorporated. Governing equations for microbial and nutrient transport are coupled with continuity and flow equations under conditions appropriate for a black oil reservoir. The computer simulator has been used to determine the effects of various transport parameters on microbial transport phenomena. The model can accurately describe the observed transport of microbes, nutrients, and metabolites in coreflooding experiments. Input parameters are determined by matching laboratory experimental results. The model can be used to predict the propagation of microbes and nutrients in a model reservoir and to optimize injection strategies. Optimization of injection strategy results in increased oil recovery due to improvements in sweep efficiency. Field-scale numerical simulation studies using data from relative permeability experiments indicated that microbial treatment could improve oil recovery over waterflooding alone. This report addresses the work conducted under project BE3 of the FY92 annual plan.

4982 (NIPER–630) **The effect of lamination angle on polymer retention: FY92 annual research plan.** Gao, H.W. National Inst. for Petroleum and Energy Research, Bartlesville, OK (United States). Sep 1992. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-83FE60149. Order Number DE93004304. Source: OSTI; NTIS; GPO Dep.

Polymer retention may be affected by the reservoir geological structure due to lamination of the mineral surfaces. These laminae are very prevalent in Class I reservoirs. To account for the effect of lamination angle on polymer retention, several corefloods with three fired, rectangular, Berea sandstone cores were conducted. The three cores were cut at three different angles, 0, 30, and 90 degrees, with respect to the direction of laminations. A multiple slug retention method was used to determine the retention of a biopolymer in each core. Tracer tests were conducted before and after the biopolymer flow to determine how the retained biopolymer affected the fluid advance. A computed tomography (CT) scanning method was used to monitor the advance of the tracer. All corefloods and tracer tests were conducted at low flow rates similar to that in reservoirs. Coreflood tests revealed that polymer retention, which was mainly caused by mechanical entrapment, was higher in cores that had laminations parallel to the direction of flow than in cores that had crossbed laminae. In cores that had crossbed laminae, polymer retention increased with an increase in the lamination angle. Retained polymer is harmful to the stability of fluid front in cores that have laminations parallel to the direction of flow, but is helpful in cores that have crossbed laminae.

4983 (NIPER–632) **Application of polymer gels for profile modification and sweep improvement of gas flooding.** Raible, C.; Zhu, T. National Inst. for Petroleum and Energy Research, Bartlesville, OK (United States). Dec 1992. 34p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-83FE60149. Order Number DE93000106. Source: OSTI; NTIS; GPO Dep.

Early CO_2 breakthrough can be a serious problem during miscible and immiscible CO_2 flooding of reservoirs with heterogeneous formations. One potential method to reduce the problem of gas channeling is the use of a gel to restrict flow of fluids into the high-permeability zones. This study included evaluation of several

different candidates for their potential as gelled polymer treatments for in situ profile modification. The objective of gel treatments is to restrict flow through fractures and high permeability zones without significantly damaging the adjacent oil productive zones. This involves injection of viscous polymer solution, hopefully into a high-permeability zone. In this study, layered sandpacks were used to show the effect of gelant mobility on gel penetration and placement. X-ray computerized tomography (CT) was used to visualize the flow path of the injected gelant and the location of gel placement. A conventional gel of xanthan and Cr(III) as a crosslinking agent was used for experimental model studies. The results of experimental model studies demonstrated the effects of viscous crossflow which may damage the oil productive strata. More specifically these studies of layered models showed that unless there is a very high-permeability contrast, such as a fractured zone, a considerable volume of viscous crossflow will occur with damage to oil productive strata. These results indicated the need for injection and placement of a low viscosity gelant prior to gelation.

4984 (RF–4/91) **Modeling of experiments connected to surfactant flooding.** Veggeland, K. Rogalandsforskning, Stavanger (Norway). Feb 1991. 35p. Order Number DE93752941. Source: OSTI; NTIS.

Phase behavior of the surfactant AS41-octane system has been measured as a function of salinity and surfactant concentration. Optimal salinity increased when increasing surfactant concentration in brine containing both mono- and divalent ions. Comparing core floods performed with constant salinity and salinity gradients showed that lowering the salinity of the drive-water helped to maintain a better phase behavior. Retention of chemicals was also lowered, due to no phase trapping of surfactants. Modeling of phase behavior is improved using the program FASE. The main improvment in FASE is the unsymmetrical binodal curve. This improvement is important for successful prediction of surfactant displacement. 6 refs., 17 figs., 12 tabs.

4985 (RF–5/91) **Phase behavior modeling in surfactant flooding: Summary of changes to the UTCHEM phase package.** Lohne, A. Rogalandsforskning, Stavanger (Norway). Mar 1991. 56p. Order Number DE93752942. Source: OSTI; NTIS.

The chemical simulation models, UTCHEM (from the University of Texas at Austin) has been used within the SPOR-Water improved oil recovery research program, in connection with experimental surfactant phase behavior measurements and surfactant floodings. This report summarizes changes and extensions to the phase package part of UTCHEM. The most important changes are: Extension of the binodal curve model to handle asymmetrical binodal curves. This has improved the reliability in phase behavior prediction over a wide range of system conditions; The cation exchange model for interaction between cations and surfactant and mineral surface, is extended to handle an arbitrary number of different cations; A new microemulsion viscosity model calculates phase viscosities as functions of both phase composition and phase type. 16 refs., 30 figs.

0204 Processing

Refer also to citation(s) 6143, 6148, 6152, 6153

4986 (UCRL–53943-91, pp. 128-132) **Coking and cracking reactions of oil vapor over oxidized shale.** Wallman, P.H.; Singleton, M.F.; Thorsness, C.B. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

The authors investigated cracking and coking reactions of oil-shale vapor in the presence of hot oxidized oil shale, both for its intrinsic importance and in support of the modeling effort on the oil-shale process. This model includes mass transfer of vapor through the gas film surrounding the shale particles with countercurrent flow of cracked low-molecular-weight products, diffusion through the pore system, adsorption onto the internal surfaces, chemical reaction of the adsorbate, and desorption of oil and light gas.

0207 Economic, Industrial, and Business Aspects

4987 (DOE/EI/20479–T3-Vol.1) **International Oil Supplies and Demands: Volume 1.** Stanford Univ., CA (United States). Energy Modeling Forum. Sep 1991. 35p. Sponsored by USDOE, Washington, DC (United States); Electric Power Research Inst., Palo Alto, CA (United States); Stanford Univ., CA (United States). Energy Modeling Forum; California Energy Resources Conservation and Development Commission, Sacramento, C DOE Contract FG01-87EI20479. (EMF–11-Vol.1). Order Number DE93006120. Source: OSTI; NTIS; INIS; GPO Dep.

The eleventh Energy Modeling Forum (EMF) working group met four times over the 1989–90 period to compare alternative perspectives on international oil supplies and demands through 2010 and to discuss how alternative supply and demand trends influence the world's dependence upon Middle Eastern oil. Proprietors of eleven economic models of the world oil market used their respective models to simulate a dozen scenarios using standardized assumptions. From its inception, the study was not designed to focus on the short-run impacts of disruptions on oil markets. Nor did the working group attempt to provide a forecast or just a single view of the likely future path for oil prices. The model results guided the group's thinking about many important longer-run market relationships and helped to identify differences of opinion about future oil supplies, demands, and dependence.

4988 (DOE/EI/20479–T3-Vol.2) **International Oil Supplies and Demands: Volume 2.** Stanford Univ., CA (United States). Energy Modeling Forum. Apr 1992. 298p. Sponsored by USDOE, Washington, DC (United States); Electric Power Research Inst., Palo Alto, CA (United States); Stanford Univ., CA (United States). Energy Modeling Forum; California Energy Resources Conservation and Development Commission, Sacramento, C DOE Contract FG01-87EI20479. (EMF–11-Vol.2). Order Number DE93006119. Source: OSTI; NTIS; INIS; GPO Dep.

The eleventh Energy Modeling Forum (EMF) working group met four times over the 1989–1990 period to compare alternative perspectives on international oil supplies and demands through 2010 and to discuss how alternative supply and demand trends influence the world's dependence upon Middle Eastern oil. Proprietors of eleven economic models of the world oil market used their respective models to simulate a dozen scenarios using standardized assumptions. From its inception, the study was not designed to focus on the short-run impacts of disruptions on oil markets. Nor did the working group attempt to provide a forecast or just a single view of the likely future path for oil prices. The model results guided the group's thinking about many important longer-run market relationships and helped to identify differences of opinion about future oil supplies, demands, and dependence.

4989 (DOE/EI/20479–T4-Vol.1) **North American Natural Gas Markets: Volume 1.** Stanford Univ., CA (United States). Energy Modeling Forum. Dec 1988. 24p. Sponsored by USDOE, Washington, DC (United States); Electric Power Research Inst., Palo Alto, CA (United States); Stanford Univ., CA (United States). Energy Modeling Forum; California Energy Resources Conservation and Development Commission, Sacramento, C DOE Contract FG01-87EI20479. (EMF–9-Vol.1). Order Number DE93006118. Source: OSTI; NTIS; INIS; GPO Dep.

This report sunnnarizes the research by an Energy Modeling Forum working group on the evolution of the North American natural gas markets between now and 2010. The group's findings are based partly on the results of a set of economic models of the natural gas industry that were run for four scenarios representing significantly different conditions: two oil price scenarios (upper and lower), a smaller total US resource base (low US resource case), and increased potential gas demand for electric generation (high US demand case). Several issues, such as the direction of regulatory policy and the size of the gas resource base, were analyzed separately without the use of models.

4990 (DOE/EI/22790–T1) **State of Missouri 1991–1992 Energy Information Administration State Heating Oil and Propane Program (SHOPP): Final report, August 9, 1991–August 8, 1992.** Missouri Dept. of Natural Resources, Jefferson City, MO (United States). Div. of Energy. [1992]. 3p. Sponsored by USDOE,

Washington, DC (United States). DOE Contract FC01-91EI22790. Order Number DE93005122. Source: OSTI; NTIS; INIS; GPO Dep.

The objective of the Missouri State Heating Oil and Propane Program was to develop a joint state-level company-specific data collective effort. The State of Missouri provided to the US Department of Energy's Energy Information Administration company specific price and volume information on residential No. 2 heating oil and propane on a semimonthly basis. The energy companies participating under the program were selected at random by the US Department of Energy and provided to the Missouri Department of Natural Resources' Division of Energy prior to the implementation of the program. The specific data collection responsibilities for the Missouri Department of Natural Resources' Division of Energy included: (1) Collection of semimonthly residential heating oil and propane prices, collected on the first and third Monday from August 1991 through August 1992; and, (2) Collection of annual sales volume data for residential propane for the period September 1, 1990 through August 31. 1991. This data was required for the first report only. These data were provided on a company identifiable level to the extent permitted by State law. Information was transmitted to the US Department of Energy's Energy Information Administration through the Petroleum Electronic Data Reporting Option (PEDRO).

4991 (DOE/EIA–0109(92/11)) **Petroleum monthly supply, November 1992.** USDOE Energy Information Administration, Washington, DC (United States). Office of Oil and Gas. 30 Nov 1992. 167p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93004611. Source: OSTI; NTIS; GPO; GPO Dep.

The Petroleum Supply Monthly (PSM) is one of a family of three publications produced by the Petroleum Supply Division within the Energy Information Administration (EIA) reflecting different levels of data timeliness and completeness. The other two publications are the Weekly Petroleum Status Report (WPSR) and the Petroleum Supply Annual (PSA). Data presented in the PSM describe the supply and disposition of petroleum products in the United States and major US geographic regions. The data series describe production, imports and exports, inter-Petroleum Administration for Defense (PAD) District movements, and inventories by the primary suppliers of petroleum products in the United States (50 States and the District of Columbia). The reporting universe includes those petroleum sectors in Primary Supply. Included are: petroleum refiners, motor gasoline blenders, operators of natural gas processing plants and fractionators, inter-PAD transporters, importers, and major inventory holders of petroleum products and crude oil. When aggregated, the data reported by these sectors approximately represent the consumption of petroleum products in the United States. Data presented in the PSM are divided into two sections (1) the Summary Statistics and (2) the Detailed Statistics.

4992 (DOE/EIA–0216(91)) **US crude oil, natural gas, and natural gas liquids reserves: Annual report, 1991.** USDOE Energy Information Administration, Washington, DC (United States). Office of Oil and Gas. 16 Nov 1992. 138p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93003986. Source: OSTI; NTIS; INIS; GPO; GPO Dep.

This report presents estimates of proved reserves of crude oil, natural gas, and natural gas liquids as of December 31, 1991, as well as production volumes for the United States, and selected States and State subdivisions for the year 1991. Estimates are presented for the following four categories of natural gas: total gas (wet after lease separation), its two major components (nonassociated and associated-dissolved gas), and total dry gas (wet gas adjusted for the removal of liquids at natural gas processing plants). In addition, two components of natural gas liquids, lease condensate and natural gas plant liquids, have their reserves and production data presented. Also included is information on indicated additional crude oil reserves and crude oil, natural gas, and lease condensate reserves in nonproducing reservoirs. A discussion of notable oil and gas exploration and development activities during 1991 is also presented.

4993 (DOE/EIA–0520(92/10)) **International petroleum statistics report, October 1992.** USDOE Energy Information Administration, Washington, DC (United States). Office of Energy Markets and End Use. 2 Nov 1992. 63p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93002750. Source: OSTI; NTIS; GPO; GPO Dep.

International Petroleum Statistics Report is a monthly publication that provides current international oil data. This report is published for the use of Members of Congress, Federal agencies, State agencies, industry, and the general public. The International Petroleum Statistics Report presents data on international oil production, demand, imports, exports, stocks. The report has four sections. Section 1 contains time series data on world oil production, and on oil and stocks in the Organization for Economic Cooperation and Development (OECD). This section contains annual a beginning in 1980, and monthly data for the most recent two years. Section 2 presents an oil supply/demand balance for world. This balance is presented in quarterly intervals for the most recent two years. Section 3 presents data on oil imports by OECD countries. This section contains annual data for the most recent year, quarterly data for the most cent two quarters, and monthly data for the most recent twelve months. Section 4 presents annual time series data on world oil production and oil stocks, demand, and trade in OECD countries. World oil production and OECD demand data are for the years 1970 through 1991; OECD stocks from 1973 through 1991; and OECD trade from 1982 through 1991.

4994 (DOE/EIA–0520(92/11)) **International petroleum statistics report, November 1992.** USDOE Energy Information Administration, Washington, DC (United States). Office of Energy Markets and End Use. 4 Dec 1992. 70p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93004467. Source: OSTI; NTIS; GPO; GPO Dep.

The International Petroleum Statistics Report presents data on international oil production, demand, imports, exports, and stocks. The report has four sections. Section 1 contains time series data on world oil production, and on oil demand and stocks in the Organization for Economic Cooperation and Development (OECD). This section contains annual data beginning in 1980, and monthly data for the most recent two years. Section 2 presents an oil supply/demand balance for world. This balance is presented in quarterly intervals for the most recent two year's. Section 3 presents data on oil imports by OECD countries. This section contains annual data for the most recent year, quarterly data for the most recent two quarters, and monthly data for the most recent twelve months. Section 4 presents annual time series data on world oil production and oil stocks, demand, and trade in OECD countries. World oil production and OECD demand data are for the years 1970 through 1991; OECD stocks from 1973 through 1991; and OECD trade from 1982 through 1991.

4995 (DOE/EIA–0520(92/12)) **International petroleum statistics report, December 1992.** USDOE Energy Information Administration, Washington, DC (United States). Office of Energy Markets and End Use. 23 Dec 1992. 67p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93005295. Source: OSTI; NTIS; GPO; GPO Dep.

The International Petroleum Statistics Report presents data on international oil production, demand, imports, exports, and stocks. The report has four sections. Section 1 contains time series data on world oil production, and on oil demand and stocks in the Organization for Economic Cooperation and Development (OECD). This section contains annual data beginning in 1980, and monthly data for the most recent two years. Section 2 presents an oil supply/demand balance for world. This balance is presented in quarterly intervals for the most recent two year's. Section 3 presents data on oil imports by OECD countries. This section contains annual data for the most recent year, quarterly data for the most recent two quarters, and monthly data for the most recent twelve months. Section 4 presents annual time series data on world oil production and oil stocks, demand, and trade in OECD countries. World oil production and OECD demand data are for the years 1970 through 1991; OECD stocks from 1973 through 1991; and OECD trade from 1982 through 1991.

4996 (DOE/EIA–0535(91)) **Fuel oil and kerosene sales 1991.** USDOE Energy Information Administration, Washington, DC (United States). Office of Oil and Gas. Nov 1992. 54p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93002955. Source: OSTI; NTIS; GPO; INIS; GPO Dep.

This publication contains the 1991 survey results of the "Annual Fuel Oil and Kerosene Sales Report" (Form EIA-821). This is the third year that the survey data have appeared in a separate publication. Prior to the 1989 report, the statistics appeared in the Petroleum Marketing Annual (PMA) for reference year 1988 and the Petroleum Marketing Monthly (PMM) for reference years 1984 through 1987, The 1991 edition marks the eighth annual presentation, of the results of the ongoing "Annual Fuel Oil and Kerosene Sales Report" survey.

4997 (DOE/EIA–0538(92/93-5)) **Winter fuels report week ending, November 6, 1992.** USDOE Energy Information Administration, Washington, DC (United States). Office of Oil and Gas. 12 Nov 1992. 81p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93002963. Source: OSTI; NTIS; GPO; GPO Dep.

The Winter Fuels Report is intended to provide concise, timely information to the industry, the press, policymakers, consumers, analysts, and State and local governments on the following topics: Distillate fuel oil net production, imports and stocks on a US level and for all Petroleum Administration for Defense Districts (PADD) and product supplied on a US level; propane net production, imports and stocks on a US level and for PADD's I, II, and III; natural gas supply and disposition and underground storage for the US and consumption for all PADD's; as well as selected National average prices; residential and wholesale pricing data for heating oil and propane for those States participating in the joint Energy Information Administration (EIA)/State Heating Oil and Propane Program; crude oil and petroleum price comparisons for the US and selected cities; and a 6–10 Day, 30-Day, and 90-Day outlook for temperature and precipitation and US total heating degree-days by city.

4998 (DOE/EIA–0538(92/93-6)) **Winter fuels report, week ending November 13, 1992.** USDOE Energy Information Administration, Washington, DC (United States). Office of Oil and Gas. 19 Nov 1992. 70p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93003369. Source: OSTI; NTIS; GPO Dep.

The Winter Fuels Report is intended to provide concise, timely information to the industry, the press, policymakers, consumers, analysts, and State and local governments on the following topics: distillate fuel oil net production, imports and stocks on a US level and for all Petroleum Administration for Defense Districts (PADD) and product supplied on a US level; propane net production, imports and stocks on a US level and for PADD's I, II, and III; natural gas supply and disposition and underground storage for the US and consumption for all PADD's; as well as selected National average prices, residential and wholesale pricing data for heating oil and propane for those States participating in the joint Energy Information Administration (EIA)/State Heating Oil and Propane Program; crude oil and petroleum price comparisons for the US and selected cities; and a 6–10 Day, 30-Day, and 90-Day outlook for temperature and precipitation and US total heating degree-days by city.

4999 (DOE/EIA–0538(92/93-7)) **Winter fuels report, week ending November 20, 1992.** USDOE Energy Information Administration, Washington, DC (United States). Office of Oil and Gas. 25 Nov 1992. 82p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93003637. Source: OSTI; NTIS; GPO Dep.

The Winter Fuels Report is intended to provide concise, timely information to the industry, the press, policymakers, consumers, analysts, and State and local governments on the following topics: distillate fuel oil net production, imports and stocks on a US level and for all Petroleum Administration for Defense Districts (PADD) and product supplied on a US level; propane net production, imports and stocks on a US level and for PADD's I, II, and III; natural gas supply and disposition and underground storage for the US and consumption for all PADD'S; as well as selected National average prices. residential and wholesale pricing data for heating oil and propane for those States participating in the joint Energy Information Administration (EIA)/State Heating Oil and Propane Program; crude oil and petroleum price comparisons for the US and selected cities; and a 6–10 Day, 30-Day, and 90-Day outlook for temperature and precipitation and US total heating degree-days by city.

5000 (DOE/EIA–0538(92/93-8)) **Winter fuels report, week ending November 27, 1992.** USDOE Energy Information Administration, Washington, DC (United States). Office of Oil and Gas. 3 Dec 1992. 80p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93002448. Source: OSTI; NTIS; GPO; GPO Dep.

The Winter Fuels Report is intended to provide concise, timely information to the industry, the press, policymakers, consumers, analysts, and State and local governments on the following topics: distillate fuel oil net production, imports and stocks on a US level and for all Petroleum Administration for Defense Districts (PADD) and product supplied on a US level; propane net production, imports and stocks on a US level and for PADD's I, II, and III; natural gas supply and disposition and underground storage for the US and consumption for all PADD'S; as well as selected National average prices. Residential and wholesale pricing data for heating oil and propane for those States participating in the joint Energy Information Administration (EIA)/State Heating Oil and Propane Program; crude oil and petroleum price comparisons for the US and selected cities; and a 6–10 Day, 30-Day, and 90-Day outlook for temperature and precipitation and US total heating degree-days by city.

5001 (DOE/EIA–0538(92/93-9)) **Winter fuels report week ending, December 4, 1992.** USDOE Energy Information Administration, Washington, DC (United States). Office of Oil and Gas. 10 Dec 1992. 79p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93004399. Source: OSTI; NTIS; GPO Dep.

The Winter Fuels Report is intended to provide concise, timely information to the industry, the press, policymakers, consumers, analysts, and State and local governments on the following topics: distillate fuel oil net production, imports and stocks on a US level and for all Petroleum Administration for Defense Districts (PADD) and product supplied on a US level; propane net production, imports and stocks on a US level and for PADD's I, II, and III; natural gas supply and disposition and underground storage for the US and consumption for all PADD'S; as well as selected National average prices. Residential and wholesale pricing data for heating oil and propane for those States participating in the joint Energy Information Administration (EIA)/State Heating Oil and Propane Program; crude oil and petroleum price comparisons for the US and selected cities; and a 6–10 Day, 30-Day, and 90-Day outlook for temperature and precipitation and US total heating degree-days by city.

5002 (OCS/MMS–92-0059) **Oil and gas leasing/production program: Annual report, FY 1991.** Heimberger, M.L. (comp.). Minerals Management Service, Herndon, VA (United States). Office of Statistics and Information. 31 Mar 1992. 96p. Sponsored by Department of the Interior, Washington, DC (United States). Source: OSTI; INIS; US Department of the Interior, Minerals Management Service, MS-4610, 381 Elden Street, Herndon, VA 22070-4817.

As the Congress declared in the Outer Continental Shelf Lands Act the natural gas and oil production from the Outer Continental Shelf constitutes an important part of the Nation's domestic energy supply. Federal offshore minerals are administered within the Department of the Interior by the Minerals Management Service (MMS), which provides access to potential new sources of natural gas and oil offshore by conducting lease sales. Each year, on or before March 31, the MMS presents to Congress a fiscal year annual report on the Federal offshore natural gas and oil leasing and production program. In FY 1991, this program was the third largest producer of non-tax revenue for the US Treasury, contributing more than $3 billion. This report presents Federal offshore leasing, sales, production, and exploration activities, and environmental monitoring activities.

0208 Waste Management

Refer also to citation(s) 5372

5003 (NEI-DK–1016) **Oil-wastes in Denmark - volume and disposal.** Arbejdsrapport fra Miljoestyrelsen, 27. Bauer, B. (Center for Alternativ Samfundsanalyse (Denmark)); Bruun Hansen, K.; Ege Joergensen, C. Miljoestyrelsen, Copenhagen (Denmark). 1992. 64p. (In Danish). Order Number DE93752790. Source: OSTI; NTIS.

The aim was to clarify the conditions of oil-wastes disposal in Denmark in relation to the amount to be disposed of - and to discover whether any effect of the stricter regulations on oil-waste disposal enforced in 1989 can be observed. Methods of disposal and environmental problems arising from alternative methods of combustion of oil wastes and possible methods of environmentally protective disposal are discussed in detail. Oil wastes in Denmark, primarily in the form of lubricating-oil wastes from industrial processes and ships, amount to roughly 40,000 tons of oily wastes every year. Of this, 14,000 tons (< 40%) were disposed of by the firm Kommunekemi A/S in 1990, so the remainder was disposed of outside this municipal system. The remainder was burned in district heating plants which has economical benefits, but the State loses taxes (50-60 mill. Danish kr. p.a.). Combustion gives emission of heavy metals and chlorine compounds etc. It is recommended that the administrative municipalities insist on registration of oil wastes delivery and receivers. Wastes should be separated according to the grade of pollution, regulations on pollution from their combustion should be more strict, analysis of the wastes' content of heavy metals should take place, and products from combustion of these wastes should be disposed of as chemicals. The risk of dioxin (etc.) production in relation to non-continuous firing with oil wastes should be investigated. Alternatives to combustion in district heating plants, and methods for disposal of the water phase in relation to separation of oil wastes should be found. (AB).

5004 (NUTEK-FBT--92-12) **Measurements of reduction of NO supplied with the primary air in grate combustion of biomass fuel.** Werle, J. (Royal Inst. of Tech., Stockholm (Sweden). Dept. of Thermal Engineering). Swedish National Board for Industrial and Technical Development (NUTEK), Stockholm (Sweden); Royal Inst. of Tech., Stockholm (Sweden). Dept. of Thermal Engineering. 1991. 52p. Project NUTEK-276-511. (TRITA-KRV--91-5). Order Number DE93753021. Source: OSTI; NTIS.

This report is a preliminary study of reducing NO in diesel exhaust by using the exhaust gases as combustion air in a grate fired furnace using biomass fuel. The experiments were performed at the Section of Combustion Technology at the National Defence Research Institute in a small scale batch fired furnace. In the experiments the diesel exhaust was simulated by adding NO to the primary air supplied through the grate. Gas samples were continuously collected in the bed during the combustion of the fuel and the gas was analysed for NO, CO, CO2 and O2. Experiments performed without NO injection show that the concentration of NO formed by combustion increases with increasing bed region air ratio, from 27 ppm NO at a bed region air ratio of 0.5 to 109 ppm at an air ratio of 1.5. When 1000 ppm NO was added to the primary air the NO-concentration was reduced to 200 ppm at a bed region air ratio of 0.5. At an air ratio of 1.5 the reduced NO concentration was 700 ppm. The experiments with 2000 ppm NO added to primary air show similar results as those with 1000 ppm added. Four types of fuels were used: coniferous chips, birchwood chips, soft wood blocks and bark/wood pellets. No differences in NO reducing capability for the different fuels could be observed. The results of the preliminary test are promising and future experiments in a full scale continuously fired reactor are recommended. (2 refs., 26 figs., 6 tabs.).

0209 Environmental Aspects

5005 (DOE/ER/12102--1) **Combustive management of oil spills: Final report.** Arizona Univ., Tucson, AZ (United States). Optical Sciences Center. [1992]. 151p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER12102. Order Number DE93005048. Source: OSTI; NTIS; INIS; GPO Dep.

Extensive experiments with in situ incineration were performed on a desert site at the University of Arizona with very striking results. The largest incinerator, 6 feet in diameter with a 30 foot chimney, developed combustion temperatures of 3000, F, and attendant soot production approximately 1000 times less than that produced by conventional in situ burning. This soot production, in fact, is approximately 30 times less than current allowable EPA standards for incinerators and internal combustion engines. Furthermore, as a consequence of the high temperature combustion, the burn rate was established at a very high 3400 gallons per hour for this particular 6 foot diameter structure. The rudimentary design studies we have carried out relative to a seagoing 8 foot diameter incinerator have predicted that a continuous burn rate of 7000 gallons per hour is realistic. This structure was taken as a basis for operational design because it is compatible with C130 flyability, and will be inexpensive enough ($120,000 per copy) to be stored at those seaside depots throughout the US coast line in which the requisite ancillary equipments (booms, service tugs, etc.) are already deployed. The LOX experiments verified our expectations with respect to combustion of debris and various highly weathered or emulsified oils. We have concluded, however, that the use of liquid oxygen in actual beach clean up is not promising because the very high temperatures associated with this combustion are almost certain to produce environmentally deleterious effects on the beach surface and its immediately sublying structures. However, the use of liquid oxygen augmentation for shore based and flyable incinerators may still play an important role in handing the problem of accumulated debris.

5006 (ETDE-mf--93742759) **Representative analysis of contents of distinct oil-separators and emulsions in Berlin and West Germany concerning the composition and the presence of harmful components. Final report.** Neuling, P. GAB Umweltzschutz Gesellschaft fuer Altstoffbeseitigung mbH, Berlin (Germany); Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Nov 1990 88p. (In German). Contract BMFT 326-4014-01450527. Order Number DE93742759. Source: OSTI; NTIS (US Sales Only).

Both in Berlin (B) and Nordrhein-Westfalen (NRW) about 150 samples have been taken out of oil-separators belonging to distinct branches. 90% of all samples have been had clearly separated oil/water-phases. Analytical results in the oil-phase (315 samples): PCB's: In the range >1,5 mg/kg in B/NRW about 50/60%, in the range >3 mg/kg about 33/37%, in the range >10 mg/kg about 8/12%, and in the range >20 mg/kg about 1/4% of the analysed oils have been PCB-containing. The highest finding frequency in the range >1.5 mg/kg has been found at the Public Institutions. - The PCB-types being found in (B), resp. in (NRW) seem to be typically distinguished: In (B) have been found overwhelmingly Clophen 40/60, while in (NRW) overwhelmingly 28/40. - Chlorine in the oil-phases have been found both in (B) and NRW in 90% of the oil-phases in the range lower than 0,05% chlorine. - The heating-energy of 90% of the oils both in (B) and (NRW) have about 40000 kJ/kg oil. - The metal-freight in the oils (192 samples) have alltogether in (B) about 150-450 mg/kg oil while in NRW about 750-1900 mg/kg oil. - Chlorphenoles (30 samples) have not to be found. Results in the water-phase (because of 30 samples, only trend-report): AOX in general low (0,1-1 mg/l), metal-freight very dependent on the pH (in acid waters about 40 mg/l, in alcaline ones about 80 mg/l), acid and alcaline water-phases only in (NRW). Conclusions: (1) Analysis of PCB-types in other regions of the FRG, finding out the origine of PCB's resp. the paths of distribution. (2) Answering the question of the dominance of PCB's distribution in the oil-separators of Publ.Inst. (3) Because of dioxin-danger intensively controlling input-checks of the waste going to the waste-burning-plant at Schoeneiche/(B). (orig.) With 11 refs., 16 tabs.

0220 Transport, Handling, and Storage

5007 (ER-B--93-01) **Boeing Petroleum Services, Inc. use of overtime at the Strategic Petroleum Reserve.** USDOE Office of Inspector General, Oak Ridge, TN (United States). Eastern Regional Audit Office. 14 Dec 1992. 22p. Sponsored by USDOE, Washington, DC (United States). Source: OSTI (Free of Charge).

The Strategic Petroleum Reserve (SPR) is responsible for purchasing and storing crude oil to mitigate the potential adverse impact of any future disruptions in crude oil imports. Boeing Petroleum Services, Inc. (BPS) operates the SPR under a US Department of Energy (DOE) management and operating contract. The objective of this audit was to determine whether BPS established and used controls to minimize the use of overtime. The audit disclosed that BPS had established procedures to minimize the use of overtime but did not enforce their use. BPS did not (1) provide timely and adequate written overtime justifications; (2) prepare adequate work schedules; (3) properly implement two employee

work shifts; or (4) adhere to DOE overtime budget constraints. These conditions existed because BPS management (a) did not ensure that established procedures were followed and (b) was primarily concerned with ensuring that the Strategic Petroleum Reserve Project Management Office (SPRPMO) contract overtime premium ceiling was not exceeded, rather than minimizing the use of overtime. During the audit, the SPRPMO manager directed BPS to institute tighter overtime controls that should reduce overtime by an estimated $2.2 million annually. Our report identifies various corrective actions for strengthening internal controls and improving the controls over overtime. Management of the SPRPMO concurred fully with the finding, associated recommendations, and estimated monetary impact.

0230 Properties and Composition

Refer also to citation(s) 5006

5008 (VTT-TIED–1359) **Heating of lubricant with an electric resistance heater.** Kytoe, M. (Technical Research Centre of Finland, Espoo (Finland). Lab. of Fuel and Process Technology). Technical Research Centre of Finland, Espoo (Finland). 1992. 33p. (In Finnish). Order Number DE93752862. Source: OSTI; NTIS.

In the experiment, three transmission oils with high-pressure additives and one circulation lubricant were heated with an electric resistance heater. The aim was to determine the limits of problem-free heating and to study changes in the lubricant during cracking. The lubricant is cracked and the heater coked in continuous heating of dozens of hours duration as soon as the temperature rises to 70-100 deg C. Circulation lubricant stands long-term heating at a surface effect of less than 2 W/cm^2 when the temperature of the lubricant is lower than 85 deg C. The corresponding temperature limit for the gear oil is about 60 deg C. The difference is due to additives: a significant part of the foul on the surface of the resistance is due to lubricant additives. The experiment indicated that short-term heating does not result in oxidation of the lubricant or in the fouling of the heating resistance. In two-hour tests the maximum temperature of the lubricant was 80 deg C and the maximum hydrocarbon content of tank air 200 ppm. In long-term tests no coking appeared with < 300 ppm hydrocarbon contents. Heating of lubricant even at temperatures below the pour point does not cause problems. The temperature peaks at the start of heating are short-term, and no heater coking or lubricant cracking appears. Formation of an explosive mixture from the cracking products is possible only if the heater is coked very strongly, when the surface temperature under the foul rises even as high as to 300 deg C.

5009 (VTT-TIED–1364) **Use of new oxygenates as gasoline components.** Nylund, N.O. (Technical Research Centre of Finland, Espoo (Finland). Lab. of Fuel and Process Technology); Kytoe, M.; Ikonen, M.; Rautiola, A.; Kokko, J. Technical Research Centre of Finland, Espoo (Finland). 1992. 94p. (In Finnish). Project KTM-SIHTI 2-5. Order Number DE93752864. Source: OSTI; NTIS.

In addition to conventional hydrocarbons, oxygen-containing component - oxygenates - are generally used in gasoline to replace lead compounds as octane boosters and to reduce exhaust emissions. Such components are alcohols and ethers, of which methyl tertiary butyl ether (MTBE) is most commonly used. Three gasoline grades were studied experimentally by engine and car tests in the laboratory and by a field test with 20 passenger cars. One of the fuels was a reference gasoline containing solely hydrocarbons, the second one contained 11 % MTBE and the third one 13 % ethyl tertiary butyl ether (FTBE). The oxygen content of the oxygenate-containing gasolines was 2 weight-%. Neither the engine performance measurements nor the field test gave differences in gasoline consumption or engine output. In driveability tests in the laboratory, the oxygenate gasolines were in cold conditions superior to the reference gasoline, while no significant differences were observed in the hot-driveability test. On the basis of the road octane requirement tests, a slightly higher octane number is required for the oxygenated fuels than for the hydrocarbon fuel. When using oxygenated fuels, the CO emission of the non-catalyst cars was reduced by 15-20 % and the HC emission by about 5 %. The corresponding reductions for the catalyst cars were 0-10 % (CO) and about 10 % (HC). The fuel had no effect on the NO_x emission. At the cold test of 30 min at -20 and +-0 deg C the CO emission of the threeway catalyst engine was reduced on average by 7 % and the HC emission by 6-11 %.

0250 Combustion

Refer also to citation(s) 5005

03 NATURAL GAS

Refer also to citation(s) 4969, 4971, 5713

0302 Reserves, Geology, and Exploration

Refer also to citation(s) 4966, 4972, 4992, 5013

5010 (DOE/MC/28079–3131) **The sensitivity of seismic responses to gas hydrates: Final report.** Foley, J.E.; Burns, D.R. New England Research, Inc., White River Junction, VT (United States). Aug 1992. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG21-91MC28079. Order Number DE93000216. Source: OSTI; NTIS; GPO Dep.

The sensitivity of seismic reflection coefficients and amplitudes, and their variations with changing incidence angles and offsets, was determined with respect to changes in the parameters which characterize marine sediments containing gas hydrates. Using the results of studies of ice saturation effects in permafrost soils, we have introduced rheological effects of hydrate saturation. The replacement of pore fluids in highly porous and unconsolidated marine sediments with crystalline gas hydrates, increases the rigidity of the sediments, and alters the ratio of compressional/shear strength ratio. This causes Vp/Vs ratio variations which have an effect on the amplitudes of P-wave and S-wave reflections. Analysis of reflection coefficient functions has revealed that amplitudes are very sensitive to porosity estimates, and errors in the assumed model porosity can effect the estimates of hydrate saturation. Additionally, we see that the level of free gas saturation is difficult to determine. A review of the effects of free gas and hydrate saturation on shear wave arrivals indicates that far-offset P to S wave converted arrivals may provide a means of characterizing hydrate saturations. Complications in reflection coefficient and amplitude modelling can arise from gradients in hydrate saturation levels and from rough sea floor topography. An increase in hydrate saturation with depth in marine sediments causes rays to bend towards horizontal and increases the reflection incidence angles and subsequent amplitudes. This effect is strongly accentuated when the vertical separation between the source and the hydrate reflection horizon is reduced. The effect on amplitude variations with offset due to a rough sea floor was determined through finite difference wavefield modelling. Strong diffractions in the waveforms add noise to the amplitude versus offset functions.

0303 Drilling, Production, and Processing

Refer also to citation(s) 5742

5011 (DOE/MC/25115–3114) **Drilling, completion, stimulation, and testing of BDM/CNGD Well 3997, Lee District, Calhoun County, West Virginia: Final report.** Overbey, W.K. Jr.; Carden, R.S.; Salamy, S.P.; Locke, C.D.; Johnson, H.R. BDM Engineering Services Co., McLean, VA (United States). Mar 1992. 160p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-89MC25115. Order Number DE92012457. Source: OSTI; NTIS; GPO Dep.

This report discusses the detailed field operations in drilling, casing, completing, and stimulating the Hunter Bennett No. 3997 well located in Lee District, Calhoun County West Virginia. The project was designed and managed by BDM in cooperation with CNG Development Company. The well was spudded on November 9, 1990, and drilling was completed on December 14, 1990. The well was drilled on an average asmuth of 312 degrees with a total horizontal displacement of 2459 feet. The well was turned to a 90 degree inclination from the vertical over a measured course length of 1216 feet. Approximately 1381 feet of the well had an inclination higher

than 86 degrees, while 2179 feet had an inclination greater than 62 degrees. The well was partitioned into five zones for stimulation purposes. Each zone is a little more than 300 feet long. The well was stimulated with nitrogen gas in zones one and two. Early production results are encouraging. The BDM/CNGD horizontal well averaged 147 mcfd of gas over the first week of production and, in week five, began to produce oil at a rate of about 2 bbl/day.

5012 (DOE/MC/25115–3115) **Drilling, completion, stimulation, and testing of Hardy HW#1 well, Putnam County, West Virginia: Final report.** Overbey, W.K. Jr.; Carden, R.S.; Locke, C.D.; Salamy, S.P. BDM Engineering Services Co., McLean, VA (United States). Mar 1992. 218p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-89MC25115. Order Number DE92012458. Source: OSTI; NTIS; GPO Dep.

This report discusses the detailed field operations in drilling, logging, casing, completing, stimulating and testing the Hardy HW No. I well located in Union District, Putnam County, West Virginia. The project was designed and managed by BDM in cooperation with Cabot Oil and Gas Corporation. The well was spudded on November 29, 1989 and was completed at a total measured depth of 6406 feet on December 29, 1989. The well was drilled on an average azimuth of 335 degrees with a total horizontal displacement of 2618 feet. Approximately 1035 feet of the well had an inclination higher than 86 degrees, while 2212 feet of the well had an inclination greater than 62 degrees. The well was partitioned into five zones for stimulation purposes. Four zones were stimulated during three stimulation operations (Zones 3 and 4 were stimulated together). Zone 1 stimulation was a successful foam frac while the stimulations on Zones 2, 3-4 were Partially successful. Initial gas production rates were 4.5 times greater than the natural production rate. After 21 months, gas produced from the BDM/Cabot well has declined at a rate about one-half that of a conventional vertical well in the area. This horizontal well is projected to produce 475 million cubic feet of gas over a 30-year period.

5013 (DOE/MC/25115–3116) **Site selection, drilling, and completion of two horizontal wells in the Devonian Shales of West Virginia: Final report.** Overbey, W.K. Jr.; Carden, R.S.; Locke, C.D.; Salamy, S.P.; Reeves, T.K.; Johnson, H.R. BDM Engineering Services Co., McLean, VA (United States). Mar 1992. 109p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-89MC25115. Order Number DE92012463. Source: OSTI; NTIS; GPO Dep.

This report presents a summary of the geologic site selection studies, planning, drilling, completing, stimulating, and testing of two horizontal wells drilled in the Devonian Shales of the Appalachian Basin in West Virginia. Each horizontal well was designed and managed by BDM as the prime contractor to the Department of Energy. The first well was drilled with industry partner Cabot Oil and Gas Corporation in Putnam County, West Virginia. The second well was drilled with Consolidated Natural Gas Company in Calhoun County, West Virginia. This report summarizes four reports prepared by BDM which detail the site selection rationale and the drilling and completion operations of each well. Each horizontal well is currently producing commercial quantities of hydrocarbons. The successful application of horizontal well technology represent continued development of the technology for application to tight and unconventional natural gas resources of the United States. Continued technology development is expected to ultimately result in commercial horizontal well drilling activity by industry in the Appalachian Basin.

5014 (UCRL–53943-91, pp. 114-116) **Biomimetic methane oxidation: Synthesis and kinetics.** Weakely, T.J.R. (Univ. of Oregon, Eugene (United States)); Droege, M.W.; Satcher, J.H. Jr.; Reibold, R.A. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

The authors have designed and prepared a binuclear, unsymmetric, coordinating ligand that is an effective metal chelator. The new ligand reacts rapidly with copper(II) to form a variety of copper coordination complexes. The authors have synthesized and characterized a binuclear copper complex, including a single-crystal, x-ray structure analysis. This complex is of significant interest because it represents proof of principle for developing coordinatively asymmetric, binuclear, metal-chelate complexes. Although this structural type of chelator now appears to be common in biological systems, it has not been previously described for inorganic synthetic coordination complexes.

5015 (UCRL–53943-91, pp. 124-127) **Bioreactor cultivation of Methylosinus trichosporium OB3b for the productions of particulate methane monooxygenase.** Shah, N.N.; Taylor, R.T.; Droege, M.W. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

Methane monooxygenases (MMOs) are enzymes that oxidize a wide variety of saturated hydrocarbons to alcohols and alkenes to epoxides. The authors studied the effects of two important medium components, copper and nitrate, on the production of a membrane-bound, particulate form of the enzyme (pMMO) in Methylosinus trichosporium OB3b for batch and continuous bioreactor culturing of this bacterium. Studies of pMMO-vs-soluble MMO structure-function relationships will provide useful information for the synthesis of catalytic materials needed to convert methane to liquid fuels.

0304 Products and By-Products

Refer also to citation(s) 5256, 5257

5016 (DOE/CE/15459–T5) **Natural gas conversion process: Sixth quarterly report.** S-Cal Research Corp., San Rafael, CA (United States). [1992]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG01-90CE15459. Order Number DE93003629. Source: OSTI; NTIS; GPO Dep.

The experimental apparatus was dismantled and transferred to a laboratory space provided by Lawrence Berkeley Laboratory (LBL) which is already equipped with a high-ventilation fume hood. This will enable us to make tests at higher gas flow rates in a safe environment. Three papers presented at the ACS meeting in San Francisco (Symposium on Natural Gas Upgrading II) April 5–10, 1992 show that the goal of direct catalytic conversion of Methane into heavier Hydrocarbons in a reducing atmosphere is actively pursued in three other different laboratories. There are similarities in their general concept with our own approach, but the temperature range of the experiments reported in these recent papers is much lower and this leads to uneconomic conversion rates. This illustrates the advantages of Methane activation by a Hydrogen plasma to reach commercial conversion rates. A preliminary process flow diagram was established for the Integrated Process, which was outlined in the previous Quarterly Report. The flow diagram also includes all the required auxiliary facilities for product separation and recycle of the unconverted feed as well as for the preparation and compression of the Syngas by-product.

0306 Economic, Industrial, and Business Aspects

Refer also to citation(s) 4992, 4997, 4998, 4999, 5000, 5001, 5002, 5900

5017 (ANL/EAIS/CP–77643) **Natural gas contracts in an emerging competitive market.** Sutherland, R.J. Argonne National Lab., IL (United States). [1992]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9210219–1: 14. annual North American conference of the International Association for Energy Economics, New Orleans, LA (United States), 26-28 Oct 1992). Order Number DE93002923. Source: OSTI; NTIS; INIS; GPO Dep.

Natural gas is being viewed by many as the fuel of the 1990s and beyond because of its environmental qualities, relatively low cost and significant domestic resource base. However, in the Fall of 1991, a group of electric utility executives met with then Deputy Secretary of Energy Henson Moore and asserted that an inability to obtain long term gas contracts meant that supplies are unreliable and construction of gas-fueled generating stations is being discouraged. This study was requested by the Deputy Secretary to address the issues surrounding long-term gas contracts and supply

reliability. The relationship between supply reliability and contracts is explained in terms of the number of buyers and sellers in a market. With the appropriate state regulatory policies, utilities can contract for gas and obtain reliable supplies at competitive market prices. Public utility commissioners are encouraged to permit utilities a free choice in signing gas contracts, but to allow only competitive market prices to be reflected in allowable fuel costs.

5018 (DOE/EI/20479–T4-Vol.2) **North American Natural Gas Markets: Volume 2.** Stanford Univ., CA (United States). Energy Modeling Forum. Feb 1989. 142p. Sponsored by USDOE, Washington, DC (United States); Electric Power Research Inst., Palo Alto, CA (United States); Stanford Univ., CA (United States). Energy Modeling Forum; California Energy Resources Conservation and Development Commission, Sacramento, C DOE Contract FG01-87EI20479. (EMF–9-Vol.2). Order Number DE93006117. Source: OSTI; NTIS; INIS; GPO Dep.

This report summarizes die research by an Energy Modeling Forum working group on the evolution of the North American natural gas markets between now and 2010. The group's findings are based partly on the results of a set of economic models of the natural gas industry that were run for four scenarios representing significantly different conditions: two oil price scenarios (upper and lower), a smaller total US resource base (low US resource case), and increased potential gas demand for electric generation (high US demand case). Several issues, such as the direction of regulatory policy and the size of the gas resource base, were analyzed separately without the use of models.

5019 (DOE/EI/20479–T4-Vol.3) **North American Natural Gas Markets: Selected technical studies: Volume 3.** Huntington, H.G.; Schuler, G.E. (eds.). Stanford Univ., CA (United States). Energy Modeling Forum. Apr 1989. 424p. Sponsored by USDOE, Washington, DC (United States); Electric Power Research Inst., Palo Alto, CA (United States); Stanford Univ., CA (United States). Energy Modeling Forum; California Energy Resources Conservation and Development Commission, Sacramento, C DOE Contract FG01-87EI20479. (EMF–9-Vol.3). Order Number DE93006116. Source: OSTI; NTIS; INIS; GPO Dep.

The Energy Modeling Forum (EMF) was established in 1976 at Stanford University to provide a structural framework within which energy experts, analysts, and policymakers could meet to improve their understanding of critical energy problems. The ninth EMF study, North American Natural Gas Markets, was conducted by a working group comprised of leading natural gas analysts and decision-makers from government, private companies, universities, and research and consulting organizations. The EMF 9 working group met five times from October 1986 through June 1988 to discuss key issues and analyze natural gas markets. This third volume includes technical papers that support many of the conclusions discussed in the EMF 9 summary report (Volume 1) and full working group report (Volume 2). These papers discuss the results from the individual models as well as some nonmodeling analysis related to US natural gas imports and industrial natural gas demand. Individual papers have been processed separately for inclusion in the Energy Science and Technology Database.

0307 Waste Management

Refer also to citation(s) 6526

0308 Environmental Aspects

Refer also to citation(s) 6526

0320 Transport, Handling, and Storage

5020 (ANL/CP–74033) **Use of geographic information systems for applications on gas pipeline rights-of-way.** Sydelko, P.J.; Wilkey, P.L. Argonne National Lab., IL (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States); Gas Research Inst., Chicago, IL (United States). DOE Contract W-31109-ENG-38. Agreement 5088-252-1770. (CONF-921152–4: International gas research conference, Orlando, FL (United States), 16-19 Nov 1992). Order Number DE93004237. Source: OSTI; NTIS; GPO Dep.

Geographic information system (GIS) applications for the siting and monitoring of gas pipeline rights-of-way (ROWS) were developed for areas near Rio Vista, California. The data layers developed for this project represent geographic features, such as landcover, elevation, aspect, slope, soils, hydrography, transportation, endangered species, wetlands, and public line surveys. A GIS was used to develop and store spatial data from several sources; to manipulate spatial data to evaluate environmental and engineering issues associated with the siting, permitting, construction, maintenance, and monitoring of gas pipeline ROWS; and to graphically display analysis results. Examples of these applications include (1) determination of environmentally sensitive areas, such as endangered species habitat, wetlands, and areas of highly erosive soils; (2) evaluation of engineering constraints, including shallow depth to bedrock, major hydrographic features, and shallow water table; (3) classification of satellite imagery for landuse/landcover that will affect ROWS; and (4) identification of alternative ROW corridors that avoid environmentally sensitive areas or areas with severe engineering constraints.

5021 (ETDE-mf–93750629) **AC corrosion and cathodic protection - field experiments. Final report.** Ruhrgas AG, Essen (Germany). 1992 58p. (In German). Contract FE-KKs F 5.4/24 B. Order Number DE93750629. Source: OSTI; NTIS (US Sales Only).

The aim of the investigation is assessing the danger of corrosion of unalloyed steels by AC currents with the simultaneous effect of cathodic protection currents. This task was caused by cases of damage to cathodically protected pipelines, where an effect of AC due to stray currents from railway plant or by induction was present in the case of parallel high voltage lines. The effects of the medium, the density of AC and DC currents, the frequency and the operating conditions were examined in project F.5.4/24A (parts A1 and A2). The main points of the present part B were the construction and execution of a field experiment and measurements with potentio-static control of the potential with super-imposed simultaneous AC current. In addition, some orientated experiments were carried out on the effect of caotings and to determine the change of the IR-free potential of a sample caused by the AC current. (orig./MM).

0340 Combustion

Refer also to citation(s) 6480

04 OIL SHALES AND TAR SANDS

5022 (UCRL–53859-91) **Energy Program annual report, 1991.** Pasternak, A. (ed.). Lawrence Livermore National Lab., CA (United States). Aug 1992. 67p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93004914. Source: OSTI; NTIS; INIS; GPO Dep.

The Energy Program emphasizes applied R&D for energy technologies that will be important to the US in the next fifty years and which may be important long after that. Historically, we have focused on coal gasification; the development of alternative liquid fuels from oil shale, coal, and natural gas; transportation uses of electric power from refuelable batteries; geothermal energy; and support of nuclear energy through the development of new technologies for the disposal of high-level nuclear waste. Our current program addresses three objectives of the National Energy Strategy: (1) To enhance energy security by ensuring stable costs, increasing energy supplies, and developing alternatives to Middle East oil. (2) To improve environmental quality by implementing energy technologies that effect better air and water quality, improve land use, and protect global environmental systems. (3) To encourage economic growth through technologies that reduce the costs of energy production, storage, transport, transmission, and distribution; promote efficiency by reducing costs and end-user services; and strengthen resiliency and flexibility of energy systems. We have just begun a major program to commercialize the technology to extract oil from the large US reserves (greater than 700 billion

barrels) of oil shale. Perhaps the single greatest barrier to the public acceptance of nuclear power is the perceived lack of a technical solution to the permanent disposal of wastes. We have developed new concepts that are aimed at improving the likelihood of technical assurance of long-term containment.

0403 Drilling, Fracturing, and Mining

5023 (SAND–92-2375C) **Momentum transfer from flowing explosive gases to spherical particles during computer simulation of blasting-induced rock motion.** Preece, D.S. Sandia National Labs., Albuquerque, NM (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930136–1: 19. annual conference on explosives and blasting techniques and 9th annual symposium on explosives and blasting research, San Diego, CA (United States), 31 Jan - 4 feb 1993). Order Number DE93004052. Source: OSTI; NTIS; GPO Dep.

A discrete element computer program, DMC (Distinct-Motion Code), has been used for several years to simulate blasting-induced rock motion. Recent enhancements of DMC's capabilities have included addition of an algorithm that couples together rock motion and gas flow. This allows the user to specify a particular explosive which also specifies equation-of-state and other parameters necessary to model explosive gas flow from the blastwell. Rock loading by the flowing gas is calculated automatically. The mechanism for calculating the rock loading is the subject of this paper. The rock motion effects the gas flow calculation by changing the porosity. DMC is currently being used on a SLTN SPARCstation 2 computer workstation.

0404 Oil Production, Recovery, and Refining

5024 (DOE/CE/15533–T1) **High efficiency shale oil recovery: First quarter report, January 1, 1992–March 31, 1992.** Adams, D.C. Energy Recovery Technology, Salt Lake City, UT (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG01-92CE15533. Order Number DE93003630. Source: OSTI; NTIS; GPO Dep.

The overall project objective is to demonstrate the high efficiency of the Adams Counter-Current shale oil recovery process. The efficiency will first be demonstrated at bench-scale, in the current phase, after which the demonstration will be extended to the operation of a small pilot plant. Thus the immediate project objective is to obtain data on oil shale retorting operations in a small batch rotary kiln that will be representative of operations in the proposed continuous process pilot plant. Although a batch oil shale sample will be sealed in the batch kiln from the start until the end of the run, the process conditions for the batch will be the same as the conditions that an element of oil shale would encounter in a large continuous process kiln. For example, similar conditions of heat-up rate (20 deg F/min during the pyrolysis), oxidation of the residue and cool-down will prevail for the element in both systems. This batch kiln is a unit constructed in a 1987 Phase I SBIR tar sand retorting project. The kiln worked fairly well in that project; however, the need for certain modifications was observed. These modifications are now underway to simplify the operation and make the data and analysis more exact. The agenda for the first three months of the project consisted of the first of nine tasks and was specified as the following four items: 1. Sample acquisition and equipment alteration: Obtain seven oil shale samples, of varying grade each 10 lb or more, and samples of quartz sand. Order equipment for kiln modification. 3. Set up and modify kiln for operation, including electric heaters on the ends of the kiln. 4. Connect data logger and make other repairs and changes in rotary batch kiln.

0409 Waste Management

5025 (DOE/LC/11084–3150) **Modeling of hydrologic conditions and solute movement in processed oil shale waste embankments under simulated climatic conditions: Second quarterly report, January 1, 1992–March 31, 1992.** Turner, J.P.; Hasfurther, V. Wyoming Univ., Laramie, WY (United States). Environmental Simulation Lab. 4 May 1992. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC21-86LC11084. Order Number DE93004828. Source: OSTI; NTIS; INIS; GPO Dep.

The scope of the research program and the continuation is to study interacting hydrologic, geotechnical, and chemical factors affecting the behavior and disposal of combusted processed oil shale. The research combines bench-scale testing with large scale research sufficient to describe commercial scale embankment behavior. The large scale approach was accomplished by establishing five lysimeters, each 7.3 x 3.0 x 3.0 m deep, filled with processed oil shale that has been retorted and combusted by the Lurgi-Ruhrgas (Lurgi) process. Approximately 400 tons of Lurgi processed oil shale waste was provided by Rio Blanco Oil Shale Co., Inc. (RBOSC) through a separate cooperative agreement with the University of Wyoming (UW) to carry out this study. Three of the lysimeters were established at the RBOSC Tract C-a in the Piceance Basin of Colorado. Two lysimeters were established in the Environmental Simulation Laboratory (ESL) at UW. The ESL was specifically designed and constructed so that a large range of climatic conditions could be physically applied to the processed oil shale which was filled in the lysimeter cells.

0410 Environmental Aspects

Refer also to citation(s) 5025

05 NUCLEAR FUELS

0501 Reserves, Exploration, and Mining

Refer also to citation(s) 5442, 6110, 6674

5026 (DOE/EI/22935–T1) **Maintaining the uranium resources data system and assessing the 1991 US uranium potential resources: Final report.** McCammon, R.B. (Geological Survey, Reston, VA (United States)); Finch, W.I.; Grundy, W.D.; Pierson, C.T. Geological Survey, Reston, VA (United States). 31 Dec 1992. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI01-92EI22935. Order Number DE93005121. Source: OSTI; NTIS; INIS; GPO Dep.

The Energy Information Administration's (EIA) Uranium Resource Assessment Data (URAD) System contains information on potential resources (undiscovered) of uranium in the United States. The purpose of this report is: (1) to describe the work carried out to maintain and update the URAD system; (2)to assess the 1991 U.S. uranium potential resources in various cost categories; and (3) to describe the progress that has been made to automate the generation of the assessment reports and their subsequent transmittal by diskette.

5027 (IAEA-TECDOC–650, pp. 159-168) **Grade and tonnage models for uranium resource assessment and exploration.** Finch, W.I. (Geological Survey, Denver, CO (United States)); McCammon, R.B. International Atomic Energy Agency, Vienna (Austria); Nuclear Energy Agency, 75 - Paris (France). Jun 1992. (CONF-9108224–: Technical committee meeting on new developments in uranium exploration, resources, production and demand, Vienna (Austria), 26-29 Aug 1991). In *New developments in uranium exploration, resources, production and demand: Proceedings of a technical committee meeting held in Vienna, 26-29 August 1991.* 258p. Order Number DE93607128. Source: OSTI; NTIS (US Sales Only); INIS.

Grade and tonnage models for uranium developed thus far are of three varieties: the standard grade and tonnage models of the U.S. Geological Survey (USGS) used in the MARK3 program to estimate undiscovered uranium ore, (2) the authors' deposit-size-frequency and average grade distribution model used to estimate undiscovered uranium endowment, and (3) the U.S. Department of Energy (DOE) grade-tonnage model used to estimate undiscovered potential uranium resources. All three of these are based on descriptive geologic models for the type of deposit being assessed. Results and much of the input data are expressed in probability

distributions. The standard grade and tonnage models, which consist of two graphs, express average grade and tonnage of ore in proportion of number of deposits plotted against a log-scale of grade and tonnage, respectively, along the abscissa. The deposit-size-frequency (DSF) method of estimating undiscovered uranium endowment uses a matrix of the probable numbers of deposits estimated in established size classes expressed in tons of mineralized rock at endowment grade combined with the distribution of the average grade of U_3O_8 for deposits in a selected control area to produce probabilistic estimates of the contained U_3O_8 in undiscovered deposits. The DOE grade-tonnage model consists of plots of the percent of uranium inventory pre-production tonnage versus grade-cutoff and the resulting average grade at different grade-cutoffs. For a selected uranium deposit type, the USGS standard grade and tonnage models can be used to predict the grade and target sizes of undiscovered deposits for exploration, especially in frontier areas. Construction of standard grade and tonnage models for some types of deposits may reveal subtypes be segregation of either grade or tonnage values into distinct distributions that can be related to specific geologic environments, thus possibly revealing relations not suspected before the modelling.

5028 (IAEA-TECDOC–650, pp. 118-127) **The discovery of the McArthur River uranium deposit, Saskatchewan, Canada.** Marlatt, J. (Cameco Corp., Saskatoon, SK (Canada)); McGill, B.; Matthews, R.; Sopuck, V.; Pollock, G. International Atomic Energy Agency, Vienna (Austria); Nuclear Energy Agency, 75 - Paris (France). Jun 1992. (CONF-9108224–: Technical committee meeting on new developments in uranium exploration, resources, production and demand, Vienna (Austria), 26-29 Aug 1991). In *New developments in uranium exploration, resources, production and demand: Proceedings of a technical committee meeting held in Vienna, 26-29 August 1991.* 258p. Order Number DE93607128. Source: OSTI; NTIS (US Sales Only); INIS.

The McArthur River P2 North uranium deposit is in the southeastern portion of the Athabasca Basin, 70 km northeast of the Key Lake uranium mine. Mineralization is in Athabasca sandstone and fault-thrusted basement graphitic metasediments, at 500 to 600 metres depth and is structurally controlled by a regional, northeasterly trending fault rooted in graphitic basement rocks. Several stages of hydrothermal alteration involving silica, illite, kaolinite, chlorite, and dravite preceded or followed the uranium mineralizing event at 1521 Ma. Early silicification, possibly related to basement quartzites, reduced sandstone permeability and limited the development of a clay alteration halo. The mineralization consists of uraninite without the cobalt-nickel-arsenide minerals found in some other unconformity-related uranium deposits. Uranium values of greater than 1 ppm form a pathfinder chimney to the bedrock surface. Mineralized sandstone boulders drew attention to this area in 1980, the regional conductor was defined geophysically in 1984-86, and drilling in 1986 located subeconomic mineralization 4.5 km southwest of the deposit. Continuing work in the area defined the characteristics of mineralization associated with the fault scarp and further drilling along the structure led to the discovery of the P2 North deposit late in 1988. A variety of geophysical techniques were used to define conductive trends and help outline alteration patterns and basement geology. Alteration patterns, structural observations and sandstone lithogeochemical signatures also guided the placement of the drill holes. The deposit has been tested by about 30 vertical drill holes spaced 50 to 100 m apart. Preliminary estimates, at the end of 1990, indicate 200 million pounds at an average grade of 4% U_3O_8. Partners in the McArthur River Joint Venture are Cameco Corporation, Uranerz Exploration and Mining Limited, Agip Resources Ltd., Interuranium Canada Limited, and Cogema Canada Ltd.

5029 (INIS-BR–2998) **Possibility study of use rare earth deposit from Araxa, Minas Gerais State.** Fernandes, M.D. Minas Gerais Univ., Belo Horizonte, MG (Brazil). Dept. de Engenheria Metalurgica. 1975[120] (In Portuguese). Order Number DE93609084. Source: OSTI; NTIS (US Sales Only); INIS.

Prospecting work done by Instituto de Pesquisas Radioativas on the Barreiro area (Araxa, M.G.) has shown the existence of a rare earth deposit of about 700.000 ton, averaging 13,5 % rare earth oxide, mainly associated to the mineral monazite. In a first stage, the conventional mineral dressing methods were tried to treat the monazite. This was followed by a study of a chemical process for the production of rare earth compounds of commercial grade. The conventional methods of mineral dressing tested did not lead to satisfactory results. This was assumed to be due to insufficient liberation of the monazite. However, the application of the chemical process to the natural material, using concentrated sulfuric acid in the initial attack, allowed more than 90% rare earth extraction and a subsequent yield of commercial grade rare earth oxide, with over 75% rare earth recovery. (author).

5030 (INIS-mf–13386, pp. 1-18) **Structure as a guide for uranium exploration in the Turamdih-Mohuldih area, Singhbhum district, Bihar.** Mohanty, R. (Department of Atomic Energy, Tatanagar (India). Atomic Minerals Div.); Verma, M.B. Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences. 1991. [472] (CONF-8912172–: International symposium on uranium technology, Bombay (India), 13 Dec 1989). In *Proceedings of the international symposium on uranium technology [held at Bombay during 13-15 Dec 1989]. V. 1.* Order Number DE93608776. Source: OSTI; NTIS (US Sales Only); INIS.

Uranium mineralisation at Turamdih is hosted by chlorite-quartz schist +/- apatite and magnetite, where as at Mohuldih, it occurs in the immediately underlying quartzite and tourmaline-bearing sericite schist. The ore horizons are in the form of a number of lodes, concordant with the schistosity of the host rocks and separated from each other by a few tens of metres of poorly-mineralised or barren rocks. Of the three deformation episodes (F_1, F_2 and F_3) decipherable in the area, evaluation drilling and structural analysis reveal that the subsurface behaviour of the ore body is mostly affected by the F_2 fold movement. Critical information on such structural guides for mineralisation will help in planning evaluation drilling programmes in the contiguous area to substantially augment the presently-known reserves of uranium. (author)., 8 refs., 9 figs., 2 tabs.

5031 (INIS-mf–13386, pp. 19-35) **Prospecting for uranium in carbonate rocks of the Vempalle formation, Cuddapah basin, Andhra Pradesh.** Vasudeva Rao, M. (Department of Atomic Energy, Bangalore (India). Atomic Minerals Div.); Nagabhushana, J.C.; Jeyagopal, A.V.; Thimmaiah, M. Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences. 1991. [472] (CONF-8912172–: International symposium on uranium technology, Bombay (India), 13 Dec 1989). In *Proceedings of the international symposium on uranium technology [held at Bombay during 13-15 Dec 1989]. V. 1.* Order Number DE93608776. Source: OSTI; NTIS (US Sales Only); INIS.

Detailed exploration of the carbonate rocks of the Vempalle Formation of the Proterozoic Cuddapah Supergroup has led to the identification of a promising stratabound uranium horizon having correlatable mineralisation of good width, grade and extent in 18 localities over a stretch of 62 Km. Sub-surface exploration at two localities (Tummalapalle and Gadankipalle) has resulted in delineation of ore bodies with good grade, sizeable tonnage, and thickness down to shallow depths of about 150 m. The exploration methodology adopted, various integrated techniques used and guides recognised during exploration, together with results obtained are discussed. Suggestions for developing exploration programmes in similar lithostratigraphic setting elsewhere in the country are also made. (author). 3 refs., 6 figs.

5032 (INIS-mf–13386, pp. 36-48) **Evaluation of favourable structural features for uranium airborne geophysical surveys over parts of Madhya Pradesh, India.** Tiku, K.L. (Department of Atomic Energy, Hyderabad (India). Atomic Minerals Div.); Krishna Rao, S.V.; Behari, Bipan. Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences. 1991. [472] (CONF-8912172–: International symposium on uranium technology, Bombay (India), 13 Dec 1989). In *Proceedings of the international symposium on uranium technology [held at Bombay during 13-15 Dec 1989]. V. 1.* Order Number DE93608776. Source: OSTI; NTIS (US Sales Only); INIS.

The aeromagnetic and aerial spectrometric data of the two areas in Bilaspur block and Raipur block are studied. The F-W magnetic lineaments stand out well and have been deduced from their magnetic signature that is due either to the lateral displacement of

magnetic horizon or its discontinuity. From spectrometric data it is seen that most uranium anomalies are located near the NW-SE faults and contact zones. (N.B.).

5033 (INIS-mf–13386, pp. 49-73) **Integrated geophysical investigations for uranium : a case study from Jamiri, West Kameng district, Arunachal Pradesh.** Srinivas, R. (Department of Atomic Energy, Hyderabad (India). Atomic Minerals Div.); Dash, J.K.; Sethuram, S.; Tiku, K.L.; Behari, Bipan. Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences. 1991. [472] (CONF-8912172–: International symposium on uranium technology, Bombay (India), 13 Dec 1989). In *Proceedings of the international symposium on uranium technology [held at Bombay during 13-15 Dec 1989]. V. 1.* Order Number DE93608776. Source: OSTI; NTIS (US Sales Only); INIS.

An integrated geophysical approach was attempted for uranium exploration in Jamiri area, Arunachal Pradesh, using the techniques of magnetic, self-potential (SP) and resistivity profiling, coupled with solid state nuclear track detection (SSNTD), to delineate favourable structures controlling uranium mineralisation in phyllitic quartzites and quartzites of the Precambrian Daling formation. Three promising zones of uranium mineralisation were recognised based on integrated results from these surveys. Magnetic survey identified lithologic contacts and faults in the area. A high-order SP anomaly of -900 millivolts was observed near the contact of phyllites in the east and phyllitic quartzites in the west. A very low resistivity of 1.0 ohm.m and high SSNTD values of 120 tracks/mm^2 over a background of 20 to 30 tracks/mm^2 were also recorded near this contact. These anomalies are characteristic of a fault that channelises radon and gives low resistivities. The SP anomaly may indicate sulphide mineralisation, and hence, uranium mineralisation in this contact zone may be associated with sulphides. The phyllitic quartzites west of this contact are characterised by magnetic highs ranging from 540 to 900 gammas. Here, SP anomalies are also small closures of -80 to -100 mV. The SSNTD values range between 100 and 120 tracks/mm^2. This rock unit (phyllitic quartzite) appears to host uranium mineralisation along with sulphides at some places where radon anomalies are high. A fault in the western portion of the area interpreted from the magnetic map separates phyllitic quartzites in the east and quartzites to its west. The faulted contact is characterised by a high SP gradient and SSNTD anomalies of 100 to 140 tracks/mm^2. This contact may also be promising for uranium mineralisation at depth. (author). 10 refs., 8 figs.

5034 (INIS-mf–13386, pp. 75-89) **Natural thermoluminescence of whole-rock as a potential tool in the exploration of sandstone-type uranium deposits : application to Lower Mahadek sandstone of Meghalaya, India.** Dhana Raju, R. (Department of Atomic Energy, Bangalore (India). Atomic Minerals Div.); Bhargava, R.C.; Selvam, A.P.; Virnave, S.N. Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences. 1991. [472] (CONF-8912172–: International symposium on uranium technology, Bombay (India), 13 Dec 1989). In *Proceedings of the international symposium on uranium technology [held at Bombay during 13-15 Dec 1989]. V. 1.* Order Number DE93608776. Source: OSTI; NTIS (US Sales Only); INIS.

Natural thermoluminiscence (NTL) study on 18 whole-rock Upper Cretaceous Lower Mahadek sandstones as well as their quartz-predominant bromoform lights from three areas - Domiasiat, Gomaghat and Pdengshakap of Meghalaya has demonstrated that NTL can be used to discriminate the uraniferous (>0.01% U_3O_8 by B/r; n=13) from barren to near barren (3-40 ppm U_3O_8 by B/r; n=5) ones due to an additional TL glow peak at relatively lower temperature (210deg +/- 10degC for whole-rock and 180deg +/- 14degC for quartz-rich bromoform lights) for the former, with one TL glow peak at relatively higher temperature (260deg +/- 10degC) for whole-rock and 230deg +/- 10degC for quartz-rich bromoform lights being common to both. A comparison of NTL glow peak patterns on whole-rock sandstone and corresponding quartz-predominant bromoform lights points out that both are much similar, with the main difference being a shift in peak towards higher side by about 30degC in case of that on whole-rock. As NTL on whole-rock is simple to take without involving the laborious and time-consuming mineral separation, it is preferable to that on separated minerals, especially when a large number of samples need to be studied during prospecting for uranium. The contrasting pattern of NTL of uraniferous from uranium-poor sandstones as well as the comparable patterns on both whole-rock and corresponding quartz-predominant bromoform lights, point to the use of NTL on whole-rock as a potential tool in exploration for sandstone-type U-mineralisation, especially for (a) deciphering the concealed mineralised zones (as TL is a net effect of long time radiation exposure) and (b) predicting the extensions of known uraniferous zones. (author). 28 refs., 2 tabs.

5035 (INIS-mf–13386, pp. 90-108) **Hydrogeochemical exploration for uranium : a case study from the Cuddapah basin, Andhra Pradesh.** Singh, R.P. (Department of Atomic Energy, Bangalore (India). Atomic Minerals Div.); Jain, P.K.; Kumar, B.R.M.; Vasudeva, S.G.; Rao, S.S.; Patwardhan, A.V. Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences. 1991. [472] (CONF-8912172–: International symposium on uranium technology, Bombay (India), 13 Dec 1989). In *Proceedings of the international symposium on uranium technology [held at Bombay during 13-15 Dec 1989]. V. 1.* Order Number DE93608776. Source: OSTI; NTIS (US Sales Only); INIS.

Hydrogeochemical surveys in the southern part of the Proterozoic Cuddapah basin, comprising the Cuddapah (mostly arenaceous and argillaceous) and the Kurnool (mostly calcareous) Supergroups were taken up on a 3-year Project basis. Nearly 2,300 samples collected in an area of 4,325 Sq.Km during the first year of the project were analysed for U, conductivity, pH, and various anions like CO_3^{2-}, HCO_3^-, Cl^-, SO_4^{2-}, and cations like Ca^{2+}, Mg^{2+}, Na^+ and K^+. The data indicate that the ground waters from the quartzitic terrain contain low uranium (2.5 to 4 ppb), whereas those from shale and limestone terrains contain comparatively higher uranium, particularly in the Upper Kurnool sequence (Koilkuntla limestone = 15 ppb; Nandyal shale = 13 ppb). The U/Conductivity ratios for these shale and limestone units range from 0.006 to 0.007. Statistical and graphical evaluation of data as well as contouring of uranium and U/conductivity values have helped in delineating sixteen anomalous zones, narrowing down the target area from over 4,000 Sq.Km. to 169 Sq.Km for follow-up studies. Most of the anomalous zones, numbering eleven, are confined to the Upper Kurnool Formation, with an average uranium content of 50 ppb (n = 158), the remaining five zones being confined to shale units of the Lower and Upper Cuddapah Groups. (author). 2 refs., 4 figs., 1 tab.

5036 (INIS-mf–13386, pp. 126-146) **Geostatistical study of Bhatin ore deposit : a case study.** Vajpai, C.V.L. (Uranium Corp. of India, Jaduguda (India)); Sharma, P.P. Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences. 1991. [472] (CONF-8912172–: International symposium on uranium technology, Bombay (India), 13 Dec 1989). In *Proceedings of the international symposium on uranium technology [held at Bombay during 13-15 Dec 1989]. V. 1.* Order Number DE93608776. Source: OSTI; NTIS (US Sales Only); INIS.

Bhatin is a small uranium deposit being worked by UCIL in Singhbhum district of Bihar. Large dispersion of R.O.M. grades have been causing a concern to a great deal from quite some time. Conventional technique adopted for reserves evaluation lacked accurate prediction of grade fluctuations. Geostatistical technique is used for reserves evaluation. Error involved in estimation is calculated. Attempt has been made to study these wide variations in predicted and achieved grades. Estimated grades of the deposit by both the techniques are compared. Efficacy of working a small deposit like Bhatin is discussed. (author). 14 refs., 11 figs.

5037 (INIS-mf–13386, pp. 204-231) **Development of mining at Jaduguda.** Bhasin, J.L. (Uranium Corp. of India, Jaduguda (India)). Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences. 1991. [472] (CONF-8912172–: International symposium on uranium technology, Bombay (India), 13 Dec 1989). In *Proceedings of the international symposium on uranium technology [held at Bombay during 13-15 Dec 1989]. V. 1.* Order Number DE93608776. Source: OSTI; NTIS (US Sales Only); INIS.

The paper deals with the development of mining and other infrastructural activities of the underground mine at Jaduguda. In the

beginning open and shrinkage methods were used but gradually changed to Cut and Fill method, the fill being the deslimed mill tailings. This method gives much better recovery and provides adequate support to the worked out areas. The main entry to the mine is via a vertical shaft, 640 meters deep. The winders for ore hoisting and the services are installed on top of the concrete tower constructed above the shaft. As the winders are the life line of the mine, a high standard of maintenance is maintained. As the mine is located at the foot hill, there is a fair amount of seepage water. The seepage and the water from the fill is pumped to surface in stages. The sumps at various levels are designed to provide storage capacity. From time to time, the technological improvements in the various mining operations are brought about. The drilling of uppers by stope wagons, use of tyre mounted loaders in the stopes, use of ammonium nitrate for blasting purposes, the use of full column grout bolts are some examples. Studies are also conducted in the ground control in underground. Constant efforts are made to improve the support system. The training courses are regularly arranged for workers to update their skills. As the job in underground is hazardous, the workers are trained in the correct and safe methods of doing the various jobs. (author). 10 figs.

5038 (INIS-mf–13386, pp. 254-283) **Recovery of uranium mineral concentrate from copper tailings.** Chakravarty, S. (Uranium Corp. of India, Jaduguda (India)); Tewari, U.K.; Beri, K.K. Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences. 1991. [472] (CONF-8912172–: International symposium on uranium technology, Bombay (India), 13 Dec 1989). In *Proceedings of the international symposium on uranium technology [held at Bombay during 13-15 Dec 1989]. V. 1.* Order Number DE93608776. Source: OSTI; NTIS (US Sales Only); INIS.

Based on the studies conducted on the samples of copper tailings from Surda Copper Concentrator plant, wet concentrating table (Diaster Diagonal Deck) was found most suitable for recovering uranium mineral concentrate. Based on this technique, uranium recovery plants were set up at Surda, Rakha and Mosabani. The recoveries obtained from Surda Uranium Recovery Plant and Rakha Uranium Recovery Plant were in the range of 40-50%. But in Mosaboni Uranium Recovery Plant which is treating copper tailings from Mosaboni Copper Concentrator Plant, the biggest concentrator plant processing nearly 2,700 MT/day of copper ore, the recovery by wet concentrating tables was found to be around 22%. Low recovery was mainly due to low concentration of uranium in ore and as well as more percentage of uranium distribution in fines which tables were unable to recover. Studies were done to recover uranium mineral concentrate from the fines with new set of equipment viz. Curved Static Screen/Bartles Mozley Separator/Cross Belt Concentrator. This gave an improvement of 14-16% only. Studies by low acid leaching in chemical process side have shown that an overall recovery of 68% can be achieved. Though the chemical process is best as far as recovery is concerned but there are several constraints. The major constraint is pertaining to environmental and pollution control. Depending on the results of studies to overcome the constraints decision for the process to be adopted will be taken up and executed. The test results and plant performance data have also been included in the paper. (author). 8 figs., 11 tabs., 1 appendix.

5039 (INIS-mf–13386, pp. 318-331) **Magnetic separation for pre-concentration of uranium values from copper plant tailings.** Jha, R.S. (Bhabha Atomic Research Centre, Hyderabad (India). Ore Dressing Section); Sreenivas, T.; Natarajan, R.; Sridhar, U.; Rao, N.K. Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences. 1991. [472] (CONF-8912172–: International symposium on uranium technology, Bombay (India), 13 Dec 1989). In *Proceedings of the international symposium on uranium technology [held at Bombay during 13-15 Dec 1989]. V. 1.* Order Number DE93608776. Source: OSTI; NTIS (US Sales Only); INIS.

Using the paramagnetic character of uranium minerals, the preconcentration of uranium bearing ores and copper plant tailings of Singhbhum area have been investigated in a pilot plant scale wet high intensity magnetic separator (WHIMS). The variables studied include magnetic field intensity, matrix drum speed feed slurry flow rate and its pulp density. The results of these investigations have shown that 75-85% of the contained uranium values could be recovered in 45-55% weight in the magnetic fraction in the case of copper plant tailings from Rakha, Surda and Mosabani. The losses in the non magnetics were primarily due to the ultrafine liberated uraninite particles not collected by WHIMS due to machine limitations and the values occurring as fine inclusions in quartz. Improved recovery can be obtained by offering higher field gradients and preventing loss of very fine liberated uranium values. High gradient magnetic separator (HGMS) offers higher field gradients. A test sample of Mosabani copper tailings studied at the Sala Magnetic Inc in HGMS has indicated superior results in comparison to WHIMS. (author). 7 refs., 3 figs., 6 tabs.

5040 (INIS-mf–13386, pp. 332-345) **Preliminary beneficiation studies on uranium ore from Tummalapalle, Andhra Pradesh.** Padmanabhan, N.P.H. (Bhabha Atomic Research Centre, Hyderabad (India). Ore Dressing Section); Sridhar, U.; Rao, N.K. Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences. 1991. [472] (CONF-8912172–: International symposium on uranium technology, Bombay (India), 13 Dec 1989). In *Proceedings of the international symposium on uranium technology [held at Bombay during 13-15 Dec 1989]. V. 1.* Order Number DE93608776. Source: OSTI; NTIS (US Sales Only); INIS.

Preliminary beneficiation studies were carried out on a small bore-hole uranium ore sample from Tummalapalle, Cuddappah district (Andhara Pradesh). Most of the uranium values occur in this reasonably vast deposit in the form of fine grained pitchblende. The host rock is essentially dolomitic/phosphatic lime-stone with small amounts of quartz and shale. The presence of such high amounts as 60-65% by weight of acid-consuming carbonate minerals forbids the adoption of the conventional acid-leaching process for uranium extraction. However, if the acid consuming material in the ore is either removed, or at the best reduced by physical separation method, without any significant loss of uranium values, the acid leaching process might still be viable both technically and economically. With this aim, preliminary studies were conducted to separate essentially the carbonates by physical separation techniques, such as calcination, quenching, desliming and flotation. Results are discussed. (author). 10 refs., 5 tabs., 1 fig.

5041 (INIS-mf–13386 A38-A53) **Uranium mining in India - past, present and future.** Batra, M.K. (Uranium Corporation of India Ltd, Jaduguda (India)). Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences. 1991. [472] (CONF-8912172–: International symposium on uranium technology, Bombay (India), 13 Dec 1989). In *Proceedings of the international symposium on uranium technology [held at Bombay during 13-15 Dec 1989]. V. 1.* Order Number DE93608776. Source: OSTI; NTIS (US Sales Only); INIS.

The mining of uranium in India in the past, present and future is discussed. Uranium Corporation of India Ltd under the administrative control of Department of Atomic Energy was formed with a specific objective of mining and milling of uranium ore in the country. Uranium recovery plants, expansion mill, bye products recovery plant were set up. Underground mining, tailing disposal, land acquisition, rehabilitation and reclaimation are discussed. Cost reduction measures in mining operations are also discussed. (N.B.).

5042 (INIS-mf–13387, pp. 431-462) **Jaduguda uranium mill : rich experiences for future challenges.** Beri, K.K. (Uranium Corp. of India, Jaduguda (India)). Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences. 1991. [653] (CONF-8912172–: International symposium on uranium technology, Bombay (India), 13 Dec 1989). In *Proceedings of the international symposium on uranium technology [held at Bombay during 13-15 Dec 1989]. V. 2.* Order Number DE93608801. Source: OSTI; NTIS (US Sales Only); INIS.

India's only uranium milling plant at Jaduguda was commissioned in 1967-68 utilising low grade uranium ore. The flowsheet of the mill and controlling parameters were based on studies done on laboratory and pilot plant scale tests at the Bhabha Atomic Research Centre, Bombay. The mill has worked upto expectation except in few areas where modifications had to be done for smooth production. Apart from this improvements in operating practices have been done based on experience gained in operating the mill, incorporating the recent technological advances. In the recent past,

the mill was expanded to increase the installed capacity by 40% and was commissioned in October 1987. The expanded mill has given the desired capacity and is working smoothly. The present paper deals with the experience gained in running the plant for the last 20 years and changes incorporated (author). 4 figs.

5043 (INIS-mf–13387, pp. 874-884) **Biosorption of uranium by yeast.** Mathur, A.K. (Department of Atomic Energy, Hyderabad (India). Atomic Minerals Div.); Muralikrishna, N.; Krishnamurthy, V.; Sankaran, R.N. Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences. 1991. [653] (CONF-8912172–: International symposium on uranium technology, Bombay (India), 13 Dec 1989). In *Proceedings of the international symposium on uranium technology [held at Bombay during 13-15 Dec 1989]. V. 2.* Order Number DE93608801. Source: OSTI; NTIS (US Sales Only); INIS.

Saccharomyces Cerevisiae, species of yeast was isolated in pure form and used as precultured biomass for absorption of uranium. 99% of the contained uranium in ion exchange eluates and uranium sulphate solutions containing 16 - 190 ppm U_3O_8 could be fixed on yeast cells in one hour. Desorption of uranium from the yeast cells is effected by 0.1 M solution of ammonium carbonate. The biomass could be recycled. The effect of bivalent ions like manganese, magnesium and trivalent ions like ferric iron and aluminium on biosorption was studied. Fe^{3+} 10 ppm, Al^{3+} 25 ppm, Mn^{2+} 500 ppm and Mg^{2+} 50 ppm concentration inhibited the biosorption capacity. The present studies reveal that Saccharomyces Cerevisiae with its rapid rate of absorption could be used as a biosorbant in the treatment of uranium mill effluents. (author). 11 refs., 2 figs., 1 tab.

5044 (INIS-mf–13387, pp. 998-1020) **Management of uranium mining and processing wastes at Turamdih project.** Puri, R.C. (Uranium Corp. of India, Jaduguda (India)); Verma, R.P. Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences. 1991. [653] (CONF-8912172–: International symposium on uranium technology, Bombay (India), 13 Dec 1989). In *Proceedings of the international symposium on uranium technology [held at Bombay during 13-15 Dec 1989]. V. 2.* Order Number DE93608801. Source: OSTI; NTIS (US Sales Only); INIS.

Based on environmental impact assessment, comprehensive plan for management of wastes has been drawn up. No solid waste from the mine is being disposed off outside the project area. The quantity of waste generated after processing of ore is large because of low content of uranium in the ore. A big tailings pond has been planned in specially selected suitable valley near the plant. No liquid effluents are to be discharged into general surrounding environment. Mine water is to be fed to the process plant. Effluents from tailings pond will be collected in a storage cum evaporation pond. All water from different zones of the project shall be collected in zonal ponds and then pumped to tailings effluent storage pond. All the ponds will be provided with requisite impervious liners. The effluents of the storage pond will be treated for removal of radium and manganese and discharged into monitoring pond. Large surface areas for various ponds are envisaged to take advantage of evaporation with aim for zero discharge. To reduce impact from gaseous emissions, high efficiency dust suppression and extraction systems shall be provided. High stacks have been incorporated for DG set, boiler plants, sulphuric acid plant and dust extraction systems for crushing and grinding section and the quality of discharges will be very much within the prescribed limits. The paper describes the management plan in detail. (author).

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5045 (DOE/ID/12584–104) **Grand Junction Projects Office site environmental report for calendar year 1991.** Chem-Nuclear Geotech, Inc., Grand Junction, CO (United States). May 1992. 150p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-86ID12584. (GJPO-ES–6). Order Number DE93002872. Source: OSTI; NTIS; INIS; GPO Dep.

This report presents information pertaining to environmental activities conducted during calendar year 1991 at the US Department of Energy's Grand Junction Projects Office (DOE-GJPO) facility in Colorado. Environmental activities conducted at the GJPO facility during 1991 included those associated with environmental compliance, site remediation, off-site dose modeling, and radiological and nonradiological monitoring. Environmental compliance activities encompassed work performed to comply with federal and state laws and regulations. The state of Colorado permitted 46 well installations (installation occurred in previous years), air emissions from several sources on the facility, and remedial action activities associated with uranium-mill-tailings removal from the facility. Site remediation activities included the removal of 110,459 tons of uranium-mill-tailings-contaminated material from the facility. The radiological and nonradiological monitoring program at the GJPO facility included monitoring of activities that generate potentially hazardous or toxic wastes and monitoring of ambient air, surface water, and ground water.

5046 (INIS-mf–13387, pp. 477-484) **Recovery of uranium by direct low acid leaching from copper concentrator tailing.** Pandey, V.M. (Uranium Corp. of India, Jaduguda (India)); Choudhary, R.U.; Sarkar, A.K.; Banerjee, A.P.; Chakraborty, A.B.; Maity, N. Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences. 1991. [653] (CONF-8912172–: International symposium on uranium technology, Bombay (India), 13 Dec 1989). In *Proceedings of the international symposium on uranium technology [held at Bombay during 13-15 Dec 1989]. V. 2.* Order Number DE93608801. Source: OSTI; NTIS (US Sales Only); INIS.

It is already established that copper ores of Singhbhum Thrust Belt contain on an average 0.01% U_3O_8. Uranium is being recovered from the tailings of Rakha, Surda and Mosaboni copper concentrators of HCL by tabling method but the recovery is low. Since the proven resources in the country are limited therefore to meet the uranium requirement it has to be obtained from all the available sources of uranium and has to be recovered to the maximum possible extent. The recovery of uranium by direct leaching method from the copper concentrator tailings in the Singhbhum thrust belt will be a step in this direction. This paper deals with the leaching characteristics of above mentioned copper concentrator tailings. The leaching efficiencies were determined both under low acid condition i.e. at pH 2 to 2.2 and also under standard conditions fixed for leaching of Jaduguda ore on laboratory scale. The leaching efficiency was found to be more or less the same but under Jaduguda ore leaching conditions the reagent consumptions were high. Therefore it was decided to conduct large scale tests under low acid conditions and the tests were conducted at 200 kg scale. Suitable leaching conditions were temperature 40-45degC, pH 2 to 2.2, emf -500 mV and leaching time 8 hrs. Under these conditions U_3O_8 leaching efficiencies were 80-82% from Rakha copper tailings, 88-90% from Surda copper tailings and 78-80% from Mosaboni copper tailings. (author). 4 tabs.

5047 (INIS-mf–13387, pp. 570-581) **Development of an integrated process for recovery of uranium from ore and its refining at the location of new uranium mill at Turamidih, Singhbum District.** Nagle, R.A. (Bhabha Atomic Research Centre, Bombay (India). Uranium Extraction Div.); Parab, S.V.; Gharat, S.S.; Giriyalkar, A.B.; Koppiker, K.S. Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences. 1991. [653] (CONF-8912172–: International symposium on uranium technology, Bombay (India), 13 Dec 1989). In *Proceedings of the international symposium on uranium technology [held at Bombay during 13-15 Dec 1989]. V. 2.* Order Number DE93608801. Source: OSTI; NTIS (US Sales Only); INIS.

The second uranium ore processing plant of Uranium Corporation of India Limited is being set up at Turumdih near Jameshedpur. This plant would incorporate several new technologies. The uranium would be eluted from loaded resin with dilute sulphuric acid, and this acidic eluate assaying around 25g U_3O_8/l would be neutralised with alkali to produce yellow cake. The next fuel fabrication plant is also expected to be located at Turamdih, close to the new uranium mill. To take advantage of this co-location of the two plants, the feasibility of integrating the two process flow sheets has been investigated. The data collected during laboratory trials on development of an integrated flow sheet are presented. The process involves introduction of the conventional

ELUEX process using the tertiary amine Alamine 336 to extract uranium from the sulphuric acid eluate solution followed by nitrate stripping of uranium from the amine phase to yield a concentrated solution of uranyl nitrate. Since this step involves a change over from a sulphate to a nitrate medium, this solution would contain appreciable amount of sulphate. Since the presence of sulphate has deleterious effect on the next step of purification, it is eliminated by precipitation as gypsum by addition of calcium nitrate. Finally, uranium is purified by solvent extraction with tributyl phosphate. The final product of uranyl solution obtained in laboratory trials has been found to pass the specifications for nuclear purity. A process flow sheet has been finalised and is undergoing large bench-scale trials. (author). 6 refs., 1 fig., 1 tab.

5048 (INIS-mf–13387, pp. 582-591) **Preparation of nuclear grade uranium oxide from Jaduguda leach liquor.** Pandey, V.M. (Uranium Corp. of India, Jaduguda (India)); Chakraborty, A.B.; Maity, N. Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences. 1991. [653] (CONF-8912172–: International symposium on uranium technology, Bombay (India), 13 Dec 1989). In *Proceedings of the international symposium on uranium technology [held at Bombay during 13-15 Dec 1989]. V. 2.* Order Number DE93608801. Source: OSTI; NTIS (US Sales Only); INIS.

Studies have been conducted on pilot plant scale for solvent extraction of uranium from sulphuric acid leach liquor for Jaduguda uranium ore using Alamine-336 in kerosene as extractant and Isodecanol as modifier. A solvent extraction set up of 10 litre/min. capacity, having 4 stages each for extraction and stripping, was used. The uranium was recovered by stripping with 1M sodium chloride solution. The MDU precipitated from strip solution contained 85% U_3O_8. Since NFC has planned to set up its plant at Turamdih and a proposal was also made to integrate the process flow sheet of UCIL and NFC, it was decided to have a detailed studies on the production of nuclear grade uranium oxide from leach liquor. The work was done in line with the eluex process adopting one more stage of solvent extraction, i.e. after leaching in sulphuric acid and filtration, the clarified solution at pH of about 2 was processed through ion exchange system for extraction of uranium. The uranium was eluted with sulphuric acid. From the eluted solution uranium was again extracted with Alamine-336 in kerosene. Isodecanol was used as modifier. The stripping was done with ammonium nitrate-nitric acid, which is not a common practice. From the nitrate solution uranium was again extracted with TBP in kerosene and stripped with acidified water. From this strip solution ammonium diuranate was precipitated and ignited to uranium oxide. A parallel work was also conducted by extracting uranium directly from leach liquor by Alamine-336 and processing further as mentioned above. In both the cases, the uranium oxide produced contained the same percentage (99.8%) of U_3O_8. (author). 7 refs.

5049 (INIS-mf–13387, pp. 592-620) **Uranium recovery from phosphoric acid.** Sivaprakash, G. (FACT Engineering and Design Organisation, Udyogamandal (India)). Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences. 1991. [653] (CONF-8912172–: International symposium on uranium technology, Bombay (India), 13 Dec 1989). In *Proceedings of the international symposium on uranium technology [held at Bombay during 13-15 Dec 1989]. V. 2.* Order Number DE93608801. Source: OSTI; NTIS (US Sales Only); INIS.

By the end of 1989, phosphoric acid production in India will reach 0.5 million tonnes per year of P_2O_5. Annual phosphoric acid imports will be around 1.5 million tonnes of P_2O_5. Phosphoric acid contains about 0.35 kg of U_3O_8 per tonne of P_2O_5. Thus even by conservative estimates, there is a potential for producing 200 to 250 tonnes of U_3O_8 per year from phosphoric acid. Because of better stability of solvent and less operational problems, DEHPA-TOPO solvent extraction process is preferred for uranium recovery from phosphoric acid. The various unit operations in the process are described in details. Successful performance of these unit operations depend on proper selection and design of the equipment. Parameters to be considered while designing the plant and equipment are discussed at some length. A brief discussion of the operational problems expected and precautions to be adopted is included. (author). 5 refs., 4 figs., 3 tabs.

5050 (INIS-mf–13387, pp. 695-700) **Preparation of metal grade uranium trioxide through ammonium diuranate precipitation route.** Ramachandran, S.R. (Bhabha Atomic Research Centre, Bombay (India). Uranium Extraction Div.); Shringarpure, P.D.; Meghal, A.M. Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences. 1991. [653] (CONF-8912172–: International symposium on uranium technology, Bombay (India), 13 Dec 1989). In *Proceedings of the international symposium on uranium technology [held at Bombay during 13-15 Dec 1989]. V. 2.* Order Number DE93608801. Source: OSTI; NTIS (US Sales Only); INIS.

The metal grade uranium trioxide should possess different physical properties as compared to the ceramic quality product. It should be a granular free flowing powder with high tap/pack density and should have high surface area etc. The properties are closely related to the physical properties of ammonium diuranate (ADU) which in turn is related to the precipitation parameters. In an effort to improve the tap density and the particle size distribution of UO_3, the precipitation of ADU has been studied at length. This paper presents the data collected during this study. The precipitation conditions optimised for plant operation are also described. (author). 2 refs., 1 fig., 2 tabs.

5051 (INIS-mf–13387, pp. 653-658) **Operating experience in the refining of uranium by solvent extraction using mixer-settler.** Roy, S.B. (Bhabha Atomic Research Centre, Bombay (India). Uranium Metal Plant); Singh, H.; Kumar, K.; Meghal, A.M.; Krishnan, V.N.; Koppiker, K.S. Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences. 1991. [653] (CONF-8912172–: International symposium on uranium technology, Bombay (India), 13 Dec 1989). In *Proceedings of the international symposium on uranium technology [held at Bombay during 13-15 Dec 1989]. V. 2.* Order Number DE93608801. Source: OSTI; NTIS (US Sales Only); INIS.

Uranium Metal Plant is using mixer-settler for last 5 years for purification of uranyl nitrate solution. The process includes extraction with tri-n-butyl phosphate (TBP) dissolved in kerosene followed by scrubbing and stripping. Part of stripped solvent is processed by alkaline washing to separate degradation products of solvent. In addition, a separate extraction unit is used for processing feed solutions containing fluoride ions. Operating experience in these stages of processing is presented in this paper. Extraction performance is sensitive to presence of siliceous solids in the aqueous feed. The solids build up in the settler and can lead to emulsion formation and flooding. Control over feed clarity and periodic cleaning of unit is found essential. Stripping unit performacne is found to be sensitive to solvent quality, phase ratios, operating flows and initial acidity. Derating of capacity was found necessary with used solvent. Alkali washing of solvent has low rate of phase separation and effect of various variables has been examined in detail. Based on experience gained modifications in process equipment are in progress. Extraction from fluoride-containing solutions has been developed and adopted on a routine production bais. Salient results are presented and analysed. Entrainment of solvent in various streams is also discussed. (author). 4 refs., 1 fig.

5052 (INIS-mf–13387, pp. 666-687) **Precipitation of ammonium diuranate : a study.** Krishnamoorthy, T.S. (Bhabha Atomic Research Centre, Bombay (India). Analytical Chemistry Div.); Mahadevan, N.; Sankar Das, M. Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences. 1991. [653] (CONF-8912172–: International symposium on uranium technology, Bombay (India), 13 Dec 1989). In *Proceedings of the international symposium on uranium technology [held at Bombay during 13-15 Dec 1989]. V. 2.* Order Number DE93608801. Source: OSTI; NTIS (US Sales Only); INIS.

The precipitation of ammonium diuranate (ADU) forms the first step in the production of UO_2 fuel for reactors, and hence the quality and consistency of the ADU precipitate is very important in industrial operations. An investigation, on the precipitation of ADU, was carried out under conditions similar to those in industrial production, to evaluate the effect of various variables on the consistency and the quality of ADU. The variables studied were concentration of uranium and ammonia, pH, temperature and form of ammonia (gas or solution). The properties studied were the

settling rate of the precipitates, surface area of the ADUs and calcined oxides and compositional characteristics of the ADUs. Multifactorial experiments and ruggedness tests were applied to identify the parameters to which the precipitation process is most vulnerable, so that such parameters may be controlled effectively. Besides, the effect and the importance of equilibrium conditions during the precipitation process, on the quality of the final ADU, was also established. The paper presents the results of these studies. (author). 6 refs., 3 figs., 7 tabs.

5053 (INIS-mf–13387, pp. 643-652) **Recovery of uranium from sea water - a laboratory study.** Jayawant, D.V. (Bhabha Atomic Research Centre, Bombay (India). Uranium Extract Div.); Iyer, N.S.; Koppiker, K.S. Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences. 1991. [653] (CONF-8912172–: International symposium on uranium technology, Bombay (India), 13 Dec 1989). In *Proceedings of the international symposium on uranium technology [held at Bombay during 13-15 Dec 1989]. V. 2.* Order Number DE93608801. Source: OSTI; NTIS (US Sales Only); INIS.

Sea water contains traces of uranium, but the volume of sea water being enormous, the total quantity of uranium available from the sources is very large. From time to time, claims have been made elsewhere that a breakthrough has been made in developing a technology to recovery this uranium at an economic cost. Studies have been carried out at Uranium Extraction Division over a few years to develop a suitable technique to separate the uranium from sea water. Studies were primarily directed towards preparation of suitable inorganic ion exchangers and studying their properties. In this paper preparation of ion exchangers based on hydrous titanium oxide and the data collected in laboratory trials on their application for uranium adsorption from sea water are presented. (author). 11 refs., 2 tabs.

5054 (INIS-mf–13387, pp. 701-707) **Studies on the preparation and characterisation of ammonium uranyl carbonate (AUC).** Krishnan, V.N. (Bhabha Atomic Research Centre, Bombay, (India). Uranium Extraction Div.); Visweswaraih, M.S.; Shringarpure, P.D.; Koppiker, K.S.; Date, V.G. Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences. 1991. [653] (CONF-8912172–: International symposium on uranium technology, Bombay (India), 13 Dec 1989). In *Proceedings of the international symposium on uranium technology [held at Bombay during 13-15 Dec 1989]. V. 2.* Order Number DE93608801. Source: OSTI; NTIS (US Sales Only); INIS.

Studies have been carried out in the laboratory on the preparation of ammonium uranyl carbonate (AUC), using concentrated solution of uranyl nitrate. The precipitation of AUC has been done by addition of $(NH_4)_2CO_3$ solution and injecting gaseous ammonia and carbon dioxide. The precipitates obtained under varying parameter have been characterised by chemical and XRD analysis and the precipitate obtained under ideal conditions have been found to have the formula $[(NH_4)_4UO_2(CO_3)_3]$. Though the studies were mainly aimed at standardising the procedures for the identification of precipitates, some of the AUC samples have been tested to see their suitability for conversion to ceramic grade UO_2 powder and its pelletisation and sintering properties of the pellets. The data collected during these studies is presented. (author). 15 refs., 3 figs., 2 tabs.

5055 (INIS-mf–13387, pp. 712-727) **UO_2 production via AUC route.** Gupta, U.C. (Nuclear Fuel Complex, Hyderabad (India)); Meena, R.; Swaminathan, N. Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences. 1991. [653] (CONF-8912172–: International symposium on uranium technology, Bombay (India), 13 Dec 1989). In *Proceedings of the international symposium on uranium technology [held at Bombay during 13-15 Dec 1989]. V. 2.* Order Number DE93608801. Source: OSTI; NTIS (US Sales Only); INIS.

Currently UO_2 is being produced from ADU route on production scale. Recently, development work was started in NFC on UO_2 production via AUC route. A set-up having a capacity of 6 Kg AUC per batch has been established. The UO_2 powder produced, was subjected to various tests including XRD, SEM and sinterability tests. The XRD results on AUC and UO_2 are found to be matching with the data published by IAEA. The SEM analysis show that the powder produced has round shape and porosity as reported by other countries. The powder is found to be free-flowing and green pellets could be made without pre-compaction, granulation or addition of binder. In view of encouraging results, a bigger set-up having a capacity of 20 Kg of AUC per batch is under fabrication. The notable feature of the process developed at NFC is that it eliminates effluent generation. In the present work calcination, reduction and stabilization were done on a batch basis in stationary tubular furnace. Development work involving improved integrated design of the furnaces for these operations has been undertaken and fabrication has also been started. (author).

5056 (INIS-mf–13387, pp. 728-749) **Analytical techniques in uranium dioxide fuel production stream at NFC.** Krishnan, T.S. (Nuclear Fuel Complex, Hyderabad (India)); Syamsunder, S.; Gopalan, B.; Ramamurthy, C.K.; Narayanaswamy, R. Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences. 1991. [653] (CONF-8912172–: International symposium on uranium technology, Bombay (India), 13 Dec 1989). In *Proceedings of the international symposium on uranium technology [held at Bombay during 13-15 Dec 1989]. V. 2.* Order Number DE93608801. Source: OSTI; NTIS (US Sales Only); INIS.

A well structured chemical quality control programme in the uranium fuel production industry calls for adoption of infallible analytical techniques. Starting from ore concentrates and other raw material ingredients, the intermediates and final products have to be systematically subjected to chemical analysis. The working methods are to be carefully standardised, periodically reviewed and updated regularly. The present paper discusses such a system dedicated to the production of uranium dioxide fuel in Nuclear Fuel Complex, Hyderabad. The salient features include sampling, process control analysis, quality control analysis and clearance, Laboratory management, etc. Measurement of uranium concentration, acidity, and percentage TBP of the various stream samples constitute the process control analysis. The quality control analysis comprises for determination of trace impurities and physical parameters in the intermediates and final products. The experience gained over the years of operation and the feed back in restructuring the analytical programme is briefly discussed. New vistas in the field are also indicated. (author). 2 figs., 7 tabs.

5057 (INIS-mf–13387, pp. 777-789) **Future trends in the processing of uranium slag generated during production of uranium metal.** Chandra, Keshava (Bhabha Atomic Research Centre, Bombay (India). Chemical Engineering Group); Singh, Mahesh; Singh, H.; Meghal, A.M.; Koppiker, K.S.; Sen, S. Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences. 1991. [653] (CONF-8912172–: International symposium on uranium technology, Bombay (India), 13 Dec 1989). In *Proceedings of the international symposium on uranium technology [held at Bombay during 13-15 Dec 1989]. V. 2.* Order Number DE93608801. Source: OSTI; NTIS (US Sales Only); INIS.

The production of uranium ingot by magnesiothermic reduction generates uranium slag (U-slag). This U-slag is in the form of hard fused blocks with partly fused soft lining material. This contains 2 to 3% of uranium metal, 400 to 1500 ppm of iron and trace amounts of other impurities. Uranium and magnesium fluoride lining material from U-slag are recovered in Uranium Metal Plant (UMP). Present process as followed at UMP is described in brief to identify the possible areas for future improvement and innovations in the existing U-slag processing technology. These areas pertain to improvements of system/equipment to minimise labour, remotisation of operations to reduce radiation exposure to the workers, reuse of nitric acid to reduce effluent generation, etc. Zero-leak-cum-double containment concept for pollution control is described. An expanded facility for processing 120 Te of U-slag annually has been conceptualised. (author). 2 figs., 6 tabs.

5058 (INIS-mf–13387, pp. 796-804) **Novel surface chemical treatment to improve the quality of sintered UO_2 pellets.** Venkataramani, B. (Bhabha Atomic Research Centre, Bombay (India). Chemistry Div.); Iyer, R.M. Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences. 1991. [653] (CONF-8912172–: International symposium on uranium technology, Bombay (India), 13 Dec 1989). In *Proceedings of the international symposium on uranium technology [held at Bombay*

during 13-15 Dec 1989]. V. 2. Order Number DE93608801. Source: OSTI; NTIS (US Sales Only); INIS.

Sintering of UO_2 to form pellets is aided when UO_2 powders with high O/U ratios are used. A novel surface chemical treatment technique has been developed to deliberately oxidise a fraction of surface uranium in UO_2 powder to hexavalent state. Controlled surface oxidation is achieved by a solid state reaction using ethylene diamine carbamate (EDC) and hydrogen peroxide vapour. EDC catalyses the oxidation of uranium by hydrogen peroxide and subsequently forms a surface complex with uranyl ions, which acts as a binder. Using UO_2 powders of varying qualities (produced in Nuclear Fuel Complex, Hyderabad), it has been demonstrated, both on laboratory and pilot-plant-scale, that, the newly developed surface chemical treatment improves the quality of the sintered UO_2 pellets and increases its grinding recovery. (author). 12 refs., 3 tabs.

5059 (INIS-mf–13387, pp. 790-795) **Quality assurance during uranium metal production at U.M.P.** Krishnan, V.N. (Bhabha Atomic Research Centre, Bombay (India). Uranium Extraction Div.); Shukla, R.D.; Visweswaraiah, M.S. Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences. 1991. [653] (CONF-8912172–: International symposium on uranium technology, Bombay (India), 13 Dec 1989). In *Proceedings of the international symposium on uranium technology [held at Bombay during 13-15 Dec 1989]. V. 2.* Order Number DE93608801. Source: OSTI; NTIS (US Sales Only); INIS.

Uranium concentrate supplied by UCIL, Jaduguda is processed at Uranium Metal Plant through several steps comprising of solvent extraction purification, precipitation, calcination, reduction, hydrofluorination and magnesio-thermic reduction to uranium metal. At each of these steps, process control and quality control are absolutely essential. The outline of the quality assurance programme followed at UMP and the important innovations/improvements introduced during the recent years are described. Most of the analyses for impurities in nuclear grade uranium are carried out at UMP itself by Atomic Absorption Spectrometry (AAS). Highlights of the improvised analytical procedures are described. (author). 4 annexures.

5060 (INIS-mf–13387, pp. 805-809) **PC based uranium enrichment analyser.** Madan, V.K. (Bhabha Atomic Research Centre, Bombay (India). Electronics Div.); Gopalakrishana, K.R.; Bairi, B.R. Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences. 1991. [653] (CONF-8912172–: International symposium on uranium technology, Bombay (India), 13 Dec 1989). In *Proceedings of the international symposium on uranium technology [held at Bombay during 13-15 Dec 1989]. V. 2.* Order Number DE93608801. Source: OSTI; NTIS (US Sales Only); INIS.

It is important to measure enrichment of unirradiated nuclear fuel elements during production as a quality control measure. An IBM PC based system has recently been tested for enrichment measurements for Nuclear Fuel Complex (NFC), Hyderabad. As required by NFC, the system has ease of calibration. It is easy to switch the system from measuring enrichment of fuel elements to pellets and also automatically store the data and the results. The system uses an IBM PC plug in card to acquire data. The card incorporates programmable interval timers (8253-5). The counter/timer devices are executed by I/O mapped I/O's. A novel algorithm has been incorporated to make the system more reliable. The application software has been written in BASIC. (author). 9 refs., 1 fig.

5061 (ORNL/RASA–92/7) **Results of the radiological survey at 27 Schlosser Drive, Rochelle Park, New Jersey (RJ004).** Foley, R.D.; Brown, K.S. Oak Ridge National Lab., TN (United States). Oct 1992. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93003760. Source: OSTI; NTIS; INIS; GPO Dep.

Maywood Chemical Works (MCW) of Maywood, New Jersey, generated process wastes and residues associated with the production and refining of thorium and thorium compounds from monazite ores from 1916 to 1956. MCW supplied rare earth metals and thorium compounds to the Atomic Energy Commission and various other government agencies from the late 1940s to the mid-1950s. Area residents used the sandlike waste from this thorium extraction process mixed with tea and cocoa leaves as mulch in their yards. Some of these contaminated wastes were also eroded from the site into Lodi Brook. At the request of the US Department of Energy (DOE), a group from Oak Ridge National Laboratory conducts investigative radiological surveys of properties in the vicinity of MCW to determine whether a property is contaminated with radioactive residues, principally ^{232}Tb, derived from the MCW site. The survey typically includes direct measurement of gamma radiation levels and soil sampling for radionuclide analyses. The survey of this site, 27 Schlosser Drive, Rochelle Park, New Jersey (RJ004), was conducted on July 14, 1991. Results of the survey demonstrated no radionuclide concentrations in excess of the DOE Formerly Utilized Sites Remedial Action Program criteria. The radionuclide distributions were not significantly different from normal background levels in the northern New Jersey area.

5062 (ORNL/RASA–92/8) **Results of the radiological survey at 31 Schlosser Drive, Rochelle Park, New Jersey (RJ003).** Foley, R.D.; Brown, K.S. Oak Ridge National Lab., TN (United States). Oct 1992. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93003761. Source: OSTI; NTIS; INIS; GPO Dep.

Maywood Chemical Works (MCW) of Maywood, New Jersey, generated process wastes and residues associated with the production and refining of thorium and thorium compounds from monazite ores from 1916 to 1956. MCW supplied rare earth metals and thorium compounds to the Atomic Energy Commission and various other government agencies from the late 1940s to the mid-1950s. Area residents used the sandlike waste from this thorium extraction process mixed with tea and cocoa leaves as mulch in their yards. Some of these contaminated wastes were also eroded from the site into Lodi Brook. At the request of the US Department of Energy (DOE), a group from Oak Ridge National Laboratory conducts investigative radiological surveys of properties in the vicinity of MCW to determine whether a property is contaminated with radioactive residues, principally ^{232}Tb, derived from the MCW site. The survey typically includes direct measurement of gamma radiation levels and soil sampling for radionuclide analyses. The survey of this site, 31 Schlosser Drive, Rochelle Park, New Jersey (RJ003), was conducted on July 14, 1991. Results of the survey demonstrated no radionuclide concentrations in excess of the DOE Formerly Utilized Sites Remedial Action Program criteria. The radionuclide distributions were not significantly different from normal background levels in the northern New Jersey area.

5063 (ORNL/RASA–92/9) **Results of the radiological survey at 37 Schlosser Drive, Rochelle Park, New Jersey (RJ002).** Foley, R.D.; Brown, K.S. Oak Ridge National Lab., TN (United States). Oct 1992. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93003762. Source: OSTI; NTIS; INIS; GPO Dep.

Maywood Chemical Works (MCW) of Maywood, New Jersey, generated process wastes and residues associated with the production and refining of thorium and thorium compounds from monazite ores from 1916 to 1956. MCW supplied rare earth metals and thorium compounds to the Atomic Energy Commission and various other government agencies from the late 1940s to the mid-1950s. Area residents used the sandlike waste from this thorium extraction process mixed with tea and cocoa leaves as mulch in their yards. Some of these contaminated wastes were also eroded from the site into Lodi Brook. At the request of the US Department of Energy (DOE), a group from Oak Ridge National Laboratory conducts investigative radiological surveys of properties in the vicinity of MCW to determine whether a property is contaminated with radioactive residues, principally ^{232}Th derived from the MCW site. The survey typically includes direct measurement of gamma radiation levels and soil sampling for radionuclide analyses. The survey of this site, 37 Schlosser Drive, Rochelle Park, New Jersey (RJ002), was conducted on July 14, 1991. Results of the survey demonstrated no radionuclide concentrations in excess of the DOE Formerly Utilized Sites Remedial Action Program criteria. The radionuclide distributions were not significantly different from normal background levels in the northern New Jersey area.

0505 Uranium Enrichment

Refer also to citation(s) 5204

5064 (DOE/IG–0316) **The Atomic Vapor Laser Isotope Separation Program.** USDOE Office of Inspector General, Washington, DC (United States). Capital Regional Audit Office. 9 Nov 1992. 24p. Sponsored by USDOE, Washington, DC (United States). Source: OSTI (Free of Charge); INIS.

Report to The Secretary.

This report provides the finding and recommendations on the audit of the Atomic Vapor Laser Isotope Separation (AVLIS) program. The status of the program was assessed to determine whether the Department was achieving objectives stated in its January 1990 Plan for the Demonstration, Transition and Deployment of AVLIS Technology. Through Fiscal Year 1991, the Department had spent about $1.1 billion to develop AVLIS technology. The January 1990 plan provided for AVLIS to be far enough along by September to enable the Department to make a determination of the technical and economic feasibility of deployment. However, the milestones needed to support that determination were not met. An estimated $550 million would be needed to complete AVLIS engineering development and related testing prior to deployment. The earliest possible deployment date has slipped to beyond the year 2000. It is recommended that the Department reassess the requirement for AVLIS in light of program delays and changes that have taken place in the enrichment market since January 1990. Following the reassessment, a decision should be made to either fully support and promote the actions needed to complete AVLIS development or discontinue support for the program entirely. Management's position is that the Department will successfully complete the AVLIS technology demonstration and that the program should continue until it can be transferred to a Government corporation. Although the auditors recognize that AVLIS may be transferred, there are enough technical and financial uncertainties that a thorough assessment is warranted.

5065 (POEF-T–3604) **Wireless data monitor technical manual.** Deck, J.W. Martin Marietta Energy Systems, Inc., Piketon, OH (United States). 21 Sep 1992. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-76OR00001. Order Number DE93002262. Source: OSTI; NTIS; GPO Dep.

This document describes the hardware and software design of a multi-site wireless data acquisition system developed for the Utilities Operations department at the Portsmouth Gaseous Diffusion Plant. Some unique features incorporated in the project are the use of packet radio modems to implement a multipoint system and the use of a commercial alpha-numeric telephone pager to allow site alarms to "chase" the operator.

0507 Fuels Production and Properties

Refer also to citation(s) 5059, 5515, 5523, 5528, 5532, 5533, 5534, 5546, 5552, 5554, 5584, 5585, 5586, 7466, 7467, 7468

5066 (ANL/EP/CP–77801) **A new swelling model and its application to uranium silicide research reactor fuel.** Hofman, G.L.; Rest, J.; Snelgrove, J.L. Argonne National Lab., IL (United States). [1992]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9209266–3: 1992 international meeting on reduced enrichment for research and test reactors, Roskilde (Denmark), 27 Sep - 1 oct 1992). Order Number DE93002932. Source: OSTI; NTIS; INIS; GPO Dep.

This document discusses a new version of the dispersion fuel behavior model currently being incorporated in DART, which has been generated. The model's description of fuel swelling - more specifically, the evaluation of fission-gas bubble morphology - is significantly improved. Although some of the assumptions underlying the basic model are derived from systems other than U_3Si_2, it represents a physically realistic interpretation of the observed irradiation behavior of U_3Si_2 over a wide range of fission densities and fission rates.

5067 (HW–20002-Del.) **P-10X design features – Part 2, Building 109-B.** Bowman, F.A. Hanford Works, Richland, WA (United States). 15 Dec 1950. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003431. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document provides a discussion of the design features for the P-10X Project needed in Building 109-B.

5068 (HW–26705-Del.) **1952 at Hanford Works.** General Electric Co., Richland, WA (United States). Nucleonics Div. 10 Apr 1953. 58p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003394. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the Hanford Works during 1952.

5069 (HW–33093-RD) **Design criteria, Part 1: B Plant reactivation, 4X Program.** Felts, W.R. Hanford Atomic Products Operation, Richland, WA (United States). 24 Sep 1954. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003442. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The purpose of this report is to present the scope for the reactivation of the bismuth phosphate separations plant in the 200 East Area.

5070 (HW–50072) **Fuels preparation department monthly report for April 1957.** Hanford Works, Richland, WA (United States). 23 May 1957. 61p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003445. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report describes the operation of the fuels preparation department for the month of April 1957. Manufacturing, employee relations, process development, plant improvements, and financial operations are described.

5071 (HW–50339-Del.) **Hanford Laboratories Operation monthly activities report, May 1957.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Jun 1957. 144p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93004484. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This is the monthly report for the Hanford Laboratories Operation, May, 1957. Metallurgy, reactor fuels, chemistry, dosimetry, separation processes, reactor technology, financial activities, visits, biology operation, physics and instrumentation research, and employee relations are discussed.

5072 (HW–50572-Del.) **Fuels Preparation Department monthly report, May 1957.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 27 Jun 1957. 56p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003413. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report describes the operation of the fuels preparation department for the month of May, 1957. Manufacturing, employee relations, process development, plant improvements, and financial operations are described.

5073 (HW–51782) **Fuels Preparation Department monthly report, July 1957.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 9 Aug 1957. 53p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003447. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report describes the operation of the fuels preparation department for the month of July 1957. Manufacturing, employee relations, process development, plant improvements, and financial operations are described.

5074 (HW–52300) **Fuels Preparation Department monthly report, August 1957.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 16 Sep 1957. 47p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003448. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report describes the operation of the fuels preparation department for the month of August, 1957. Manufacturing, employee relations, process development, plant improvements, and financial operations are described.

5075 (HW–52833) **Fuels Preparation Department monthly report for September 1957.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 17 Oct 1957. 48p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003450. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report describes the operation of the fuels preparation department for the month of September, 1957. Manufacturing employee relations, process development, plant improvements and financial operations are described.

5076 (HW–52859-Del.) **Hanford Laboratories Operation monthly activities report, September 1957.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Oct 1957. 157p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93004485. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This is the monthly report for the Hanford Laboratories Operation, September, 1957. Metallurgy, reactor fuels, chemistry, dosimetry, separation processes, reactor technology, financial activities, visits, biology operation, physics and instrumentation research, and employee relations are discussed.

5077 (HW–53725) **Fuels Preparation Department monthly report for November 1957.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 20 Dec 1957. 49p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003451. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report describes the operation of the fuels preparation department for the month of November 1957. Manufacturing employee relations, process development, plant improvements and financial operations are described.

5078 (HW–54745) **Fuels Preparation Department monthly report, January 1958.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 28 Feb 1958. 53p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003516. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report describes the operation of the fuels preparation department for the month of January, 1958. Manufacturing, employee relations, process development, plant improvements, and financial operations are described.

5079 (HW–55195) **Fuels Preparation Department monthly report, February 1958.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 19 Mar 1958. 51p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003517. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report describes the operation of the fuels preparation department for the month of February, 1958. Manufacturing employee relations, process development, plant improvements and financial operations are described.

5080 (HW–55582) **Fuels Preparation Department monthly report for March 1958.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Apr 1958. 46p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003518. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the Fuels Preparation Department during the month of March 1958.

5081 (HW–55940) **Fuels Preparation Department monthly report for April 1958.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 May 1958. 46p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003452. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report describes the operation of the fuels preparation department for the month of April 1958. Manufacturing, employee relations, process development, plant improvements, and financial operations are described.

5082 (HW–56618) **Fuels Preparation Department monthly report for June 1958.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 17 Jul 1958. 46p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003453. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report describes the operation of the fuels preparation department for the month of June 1958. Manufacturing, employee relations, process development, plant improvements, and financial operations are described.

5083 (HW–57111) **Fuels Preparation Department monthly report for July 1958.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 19 Aug 1958. 43p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003455. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report describes the operation of the fuels preparation department for the month of July 1958. Manufacturing, employee relations, process development, plant improvements, and financial operations are described.

5084 (HW–57385) **Fuels Preparation Department monthly report, August 1958.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 23 Sep 1958. 47p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003521. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report describes the operation of the fuels preparation department for the month of August 1958. Manufacturing employee relations, process development, plant improvements and financial operations are described.

5085 (HW–57702) **Fuels Preparation Department monthly report for September 1958.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 23 Oct 1958. 45p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003522. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report describes the operation of the fuels preparation department for the month of September, 1958. Manufacturing employee relations, process development, plant improvements and financial operations are described.

5086 (HW–58482) **Fuels Preparation Department monthly report for November 1958.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 23 Dec 1958. 44p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003524. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report describes the operation of the fuels preparation department for the month of November, 1958. Manufacturing employee relations, process development, plant improvements and financial operations are described.

5087 (INIS-mf–13387, pp. 750-755) **Improvements in process technology for uranium metal production.** Meghal, A.M. (Bhabha Atomic Research Centre, Bombay (India). Uranium Extraction Div.); Singh, H.; Koppiker, K.S. Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences. 1991. [653] (CONF-8912172–: International symposium on uranium technology, Bombay (India), 13 Dec 1989). In *Proceedings of the international symposium on uranium technology [held at Bombay during 13-15 Dec 1989]. V. 2.* Order Number DE93608801. Source: OSTI; NTIS (US Sales Only); INIS.

The research reactors in Trombay use uranium metal as a fuel. The plant to produce nuclear grade uranium metal ingots has been in operation at Trombay since 1959. Recently, the capacity of the plant has been expanded to meet the additional demand of the uranium metal. The operation of the expanded plant, has brought to the surface various shortcomings. This paper identifies various problems and describes the measures to be taken to upgrade the technology. Some comments are made on the necessity for development of technology for future requirement. (author). 6 refs., 1 fig.

5088 (INIS-mf–13387, pp. 756-761) **Improvements in equipment design for hydrofluorination of UO_2 to UF_4.** Vedak,

A.V. (Bhabha Atomic Research Centre, Bombay (India). Uranium Extraction Div.); Kerkar, R.N.; Meghal, A.M. Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences. 1991. [653] (CONF-8912172--: International symposium on uranium technology, Bombay (India), 13 Dec 1989). In *Proceedings of the international symposium on uranium technology [held at Bombay during 13-15 Dec 1989]. V. 2.* Order Number DE93608801. Source: OSTI; NTIS (US Sales Only); INIS.

Uranium-tetrafluoride (UF_4) is a key intermediate compound required for the production of uranium metal. In the Uranium Metal Plant at Trombay, this important material is produced by reacting uranium dioxide with anhydrous hydrofluoric acid gas in a directly heated kiln type rotary tubular converter. Because of corrosive and hazardous nature of AHF, the seals of such converters leak and it is necessary the seals should be reliable and have longer life. The development programme was, therefore, taken up to modify the seal and other accessories to increase seal-life and throughput. This paper describes the development work carried out, operating experience and benefits resulting from the modification. It also outlines the future plans for improvisations. (author). 3 figs.

5089 (INIS-mf--13387, pp. 897-901) **Radioactivity levels in the process streams of Uranium Metal Plant at Trombay.** Pushparaja (Bhabha Atomic Research Centre, Bombay (India). Health Physics Div.); Sahasrabudhe, S.G.; Abraham, J.V.; Nambiar, P.P.V.J.; Iyer, M.R. Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences. 1991. [653] (CONF-8912172--: International symposium on uranium technology, Bombay (India), 13 Dec 1989). In *Proceedings of the international symposium on uranium technology [held at Bombay during 13-15 Dec 1989]. V. 2.* Order Number DE93608801. Source: OSTI; NTIS (US Sales Only); INIS.

During processing of uranium concentrate from Jaduguda at UMP, daughter products of uranium are encountered at the various stages of uranium metal production. In this paper data on the gamma spectrometric determination of radionuclides in the process stream of Uranium Metal Plant are presented. thorium-234, protactinium-234 and radium-226 are the main radionuclides present in the process streams. Radium-226 is present in the feed uranyl nitrate and does not get fully eliminated in the solvent extraction stage and appears in subsequent stages in varying concentrations. It is also important to know the radium-226 concentration in the liquid effluent before it is discharged to the sea. The concentration of radium-226 in the raffinate after treatment is about 1.5 Bq/ml. Chemical analysis of the solid raffinate cake showed significant amount of radium-226 (115 Bq/Kg). The data indicated that radium-226 in liquid effluents does not pose any significant radiation hazard. However, the beta activity due to thorium-234 and protactinium-234 could be high in ADU filtrate and needs to be controlled before its disposal to the sea. (author). 3 refs., 2 tabs.

5090 (ORNL/RASA--92/5) **Results of the radiological survey at the former ALCOA New Kensington Works, Pine and Ninth Streets, New Kensington, Pennsylvania (ANK002).** Foley, R.D.; Brown, K.S. Oak Ridge National Lab., TN (United States). Oct 1992. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93003758. Source: OSTI; NTIS; INIS; GPO Dep.

At the request of the US Department of Energy (DOE), a team from Oak Ridge National Laboratory conducted a radiological survey at the former ALCOA New Kensington Works, Pine and Ninth Streets, New Kensington, Pennsylvania. The survey was performed on November 12, 1991. The purpose of the survey was to determine whether the property was contaminated with radioactive residues, principally, as a result of work done for the Manhattan Engineer District in 1944. The survey included a gamma scan of three bays inside Building 18; measurement of direct alpha and beta-gamma levels in the same area; and collection of a dust sample for radionuclide analysis from the center of each bay. Results of the survey demonstrated no radionuclide concentrations or radiation measurements in excess of the DOE Formerly Utilized Sites Remedial Action Program guidelines for uranium. The radionuclide distributions were not significantly different from typical background levels in the Pittsburgh, Pennsylvania area.

5091 (RL-SEP--282) **Chemical Processing Department monthly report, January 1965.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 23 Feb 1965. 41p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002449. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report details activities of the Chemical Processing Department during the month of January 1965.

5092 (RL-SEP--405-Del.) **Chemical Processing Department monthly report, March 1965.** Hanford Atomic Products Operation, Richland, WA (United States). 22 Apr 1965. 40p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003971. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report, from the Chemical Processing Department at HAPO, discusses the following: Production operation; Purex and Redox operation; Finished products operation; maintenance; Financial operations; facilities engineering; research; and employee relations.

5093 (WHC-SP--0852) **Maintenance Implementation Plan for the 300 Area Nuclear Facilities: 308 fuels fabrication, N fuels fabrication, and 340 facility and tanker operations.** Westinghouse Hanford Co., Richland, WA (United States). Jun 1992. 57p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93001673. Source: OSTI; NTIS; GPO Dep.

This Maintenance Implementation Plan (MIP) has been developed for the 300 Area Nuclear Facilities, consisting of 308, 340, and N Fuels. It is based on assessments of the existing maintenance program(s) to the requirements specified by US Department of Energy (DOE) Order 4330.4A, Chapter 2, Change #3 (DOE 1990). The results of these assessments were then evaluated to determine corrective actions required. The objective of this plan is to provide baseline information utilized in establishing programs to meet the requirements of the DOE Order. The prime consideration in applying a graded approach to the proposed programs has been for maintaining (or re-establishing) safe personnel and environmental conditions. The existing maintenance program(s) which maintain and preserve facility structure(s) and essential systems will continue and will be included as part of the new programs.

0508 Spent Fuels Reprocessing

Refer also to citation(s) 5092, 5515, 6107, 6147, 6557, 6698

5094 (ANL--92/36) **Actinide recovery using aqueous biphasic extraction: Initial developmental studies.** Chaiko, D.J.; Mensah-Biney, R.; Mertz, C.J.; Rollins, A.N. Argonne National Lab., IL (United States). Aug 1992. 59p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93002314. Source: OSTI; NTIS; INIS; GPO Dep.

Aqueous biphasic extraction systems are being developed to treat radioactive wastes. The separation technique involves the selective partitioning of either solutes or colloid-size particles between two scible aqueous phases. Wet grinding of plutonium residues to an average particle size of one micron will be used to liberate the plutonium from the bulk of the particle matrix. The goal is to produce a plutonium concentrate that will integrate with existing and developing chemical recovery processes. Ideally, the process would produce a nonTRU waste stream. Coupling physical beneficiation with chemical processing will result in a substantial reduction in the volume of mixed wastes generated from dissolution recovery processes. As part of this program, we will also explore applications of aqueous biphasic extraction that include the separation and recovery of dissolved species such as metal ions and water-soluble organics. The expertise and data generated in this work will form the basis for developing more cost-effective processes for handling waste streams from environmental restoration and waste management activities within the DOE community. This report summarizes the experimental results obtained during the first year of this effort. Experimental efforts were focused on elucidating the surface and solution chemistry variables which govern partitioning behavior of plutonium and silica in aqueous biphasic

extraction systems. Additional efforts were directed toward the development of wet grinding methods for producing ultrafine particles with diameters of one micron or less.

5095 (ANL/CMT/CP–77849) **IFR fuel cycle–pyroprocess development.** Laidler, J.J.; Miller, W.E.; Johnson, T.R.; Ackerman, J.P.; Battles, J.E. Argonne National Lab., IL (United States). [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9211114–1: OECD/NEA meeting: international information exchange program on actinide and fission product separation and transmutation, Chicago, IL (United States), 11-13 Nov 1992). Order Number DE93002901. Source: OSTI; NTIS; INIS; GPO Dep.

The Integral Fast Reactor (IFR) fuel cycle is based on the use of a metallic fuel alloy, with nominal composition U-2OPu-IOZr. In its present state of development, this fuel system offers excellent high-burnup capabilities. Test fuel has been carried to burnups in excess of 20 atom % in EBR-II irradiations, and to peak burnups over 15 atom % in FFTF. The metallic fuel possesses physical characteristics, in particular very high thermal conductivity, that facilitate a high degree of passive inherent safety in the IFR design. The fuel has been shown to provide very large margins to failure in overpower transient events. Rapid overpower transient tests carried out in the TREAT reactor have shown the capability to withstand up to 400% overpower conditions before failing. An operational transient test conducted in EBR-II at a power ramp rate of 0.1% per second reached its termination point of 130% of normal power without any fuel failures. The IFR metallic fuel also exhibits superior compatibility with the liquid sodium coolant. Equally as important as the performance advantages offered by the use of metallic fuel is the fact that this fuel system permits the use of an innovative reprocessing method, known as "pyroprocessing," featuring fused-salt electrorefining of the spent fuel. Development of the IFR pyroprocess has been underway at the Argonne National Laboratory for over five years, and great progress has been made toward establishing a commercially-viable process. Pyroprocessing offers a simple, compact means for closure of the fuel cycle, with anticipated significant savings in fuel cycle costs.

5096 (DOE/DP–0111T) **Operational Readiness Review, Rocky Flats Plant, Building 707.** USDOE Assistant Secretary for Defense Programs, Washington, DC (United States). Operational Readiness Review Team. Dec 1992. 102p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93005378. Source: OSTI; NTIS; GPO Dep.

The Operational Readiness Review (ORR) is one of several activities to be completed prior to resuming plutonium operations in Building 707 at the Rocky Flats Plant. The Secretary of Energy will rely in part on the results of this ORR in deciding whether the resumption criteria for Building 707 have been meet. Shortly after assuming management responsibilities for the Rocky Flats Plant in January 1990, EG&G recommended that plutonium production operations be suspended until corrective actions could be made for improved plant operations. In April 1992, the mission of Building 707 was changed from production to contingency for future production if needed. As a result the resumption of plutonium operations will be for reprocessing plutonium into a more suitable form for safe storage or transportation. The US Department of Energy (DOE) Operational Readiness Review (ORR) onsite review was conducted September 21, 1992, to October 2, 1992, and November 2, 1992, to November 13, 1992. The review covered three major areas; (1) Plant and Equipment Readiness, (2) Personnel Readiness, and (3) Management Systems. The ORR Team was comprised of approximately 30 members consisting of a Team Leader, Senior Safety Experts, and Technical Experts. The ORR objectives and criteria were based on DOE orders, industry standards, Institute of Nuclear Power Operations guidelines, recommendations of external oversight groups, and experience of the Team members. The ORR Team has concluded that Building 707 can resume plutonium handling activities, as specified by the current mission directives and can be safely operated, after verifying correction of the findings that are described in this report and after other resumption findings from previous reviews are corrected. Continued operation of Building 707 also requires timely correction of the observations listed in this report.

5097 (HW–61736-Del.) **Chemical Processing Department monthly report for August 1959.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 21 Sep 1959. 66p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003043. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report, from the Chemical Processing Department at HAPO, discusses the following: Production operation; Purex and Redox operation; Finished products operation; maintenance; Financial operations; facilities engineering; research; and employee relations.

5098 (HW–64576-Del.) **Chemical Processing Department monthly report for March 1960.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 21 Apr 1960. 48p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93001607. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the chemical processing department as compiled by the operation managers during the month of March, 1960.

5099 (HW–71187-Del.) **Chemical Processing Department monthly report, September 1961.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 20 Oct 1961. 46p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93004395. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report, from the Chemical Processing Department at HAPO, discusses the following: Production operation; Purex and Redox operation; Finished products operation; maintenance; Financial operations; facilities engineering; research; and employee relations.

5100 (HW–72154-Del.) **Chemical Processing Department monthly report, December 1961.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 22 Jan 1962. 43p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93004396. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report, from the Chemical Processing Department at HAPO, discusses the following: Production operation; Purex and Redox operation; Finished products operation; maintenance; Financial operations; facilities engineering; research; and employee relations.

5101 (INIS-mf–13387, pp. 688-694) **A continuous reactor system for precipitation of uranium from uranyl solution.** Siddiqui, I.A. (Bhabha Atomic Research Centre, Bombay (India). Process Engineering and Systems Div.); Shah, B.V.; Tadphale, S.H.; Kumar, S.V. Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences. 1991. [653] (CONF-8912172–: International symposium on uranium technology, Bombay (India), 13 Dec 1989). In *Proceedings of the international symposium on uranium technology [held at Bombay during 13-15 Dec 1989]. V. 2.* Order Number DE93608801. Source: OSTI; NTIS (US Sales Only); INIS.

A continuous reactor system for conversion of uranium from the Purex tail-end to yellow cake has been developed. This system has been successfully used in the ADU conversion plant of Plutonium Plant, Trombay. Precipitation of uranium is carried out with gaseous ammonia in a compact continous reactor with low hold-up volumes. The system has been designed for reliable and efficient operation with minimum operator-intervention and is very stable to disturbance due to changes in feed quality and feed rate. No elaborate instrumentation is required. The operation is uncomplicated with straight-forward start-up, shut-down and freeze procedures. The reactants are agitated by air passed into the reactor. The pH of the product overflow is measured in-line and is maintained at the desired value by automatic control of flowrate of ammonia gas. The reactor is capable of handling uranyl nitrate feed over a wide range of acidity, uranium content and feed flowrates without difficulty and loss of material. The pilot plant reactor of 22 lit active volume can process 10 to 12 kg uranium per hour. The reactor system and the associated instrumentation are described and design parameters of the system are discussed. (author). 2 refs., 4 figs.

5102 (INIS-mf–13387, pp. 865-873) **Limits of plutonium contamination in reprocessed uranium for handling in uranium**

plants. Sundaram, V.K. (Bhabha Atomic Research Centre, Bombay (India). Health Physics Div.); Iyer, M.R. Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences. 1991. [653] (CONF-8912172--: International symposium on uranium technology, Bombay (India), 13 Dec 1989). In *Proceedings of the international symposium on uranium technology [held at Bombay during 13-15 Dec 1989]. V. 2.* Order Number DE93608801. Source: OSTI; NTIS (US Sales Only); INIS.

The use of depleted uranium in plants handling natural uranium calls for setting up limits of plutonium and transplutonics, since their presence would pose additional handling hazards. The limits should be such that the health physics precautions adopted for natural uranium should be adequate for handling the reprocessed uranium. For this purpose Derived Air Concentration (DAC) values for mixtures of plutonium and transplutonics in reprocessed fuel from PHWR reactors of various burn-ups and cooling periods have been arrived at. All the alpha emitters that build up in the fuel are taken into account. The activity of the various radio-nuclides are computed using the isotope generation code, ORIGEN 2 and the DAC values are taken from ICRP publication 30. The DAC of the mixture is found to be more or less constant with burn up for cooling times more than 2 years. At shorter times the DAC of the mixture is found to increase with burn up as ^{242}Cm with a half-life of 163 days and a relatively high DAC of 163 days and a relatively higher DAC of 4 Bq/m^3 forms a significant fraction of the activity. Based on DAC for the mixture, limits of plutonium contamination in reprocessed uranium are arrived at. The criterion used in obtaining the limit is that the additional radio-toxicity due to the presence of plutonium and transplutonics is equal to the toxicity of uranium. The limit is found to be lower by a factor of 2 for uranium with a burnup of 6500 MWD/T than that with a burnup of 100 MWD/T. (author). 1 ref., 2 figs., 1 tab.

5103 (RL-SEP–509-Del.) **Chemical Processing Department monthly report, May 1965.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 21 Jun 1965. 43p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003972. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report, from the Chemical Processing Department at HAPO, discusses the following: Production operation; Purex and Redox operation; Finished products operation; maintenance; Financial operations; facilities engineering; research; and employee relations.

5104 (RL-SEP–654-Del.) **Chemical Processing Department monthly report, July 1965.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 23 Aug 1965. 40p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003973. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report, from the Chemical Processing Department at HAPO, discusses the following: Production operation; Purex and Redox operation; Finished products operation; maintenance; Financial operations; facilities engineering; research; and employee relations.

5105 (RL-SEP–706-Del.) **Chemical Processing Department monthly report, August 1965.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 21 Sep 1965. 41p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003974. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report, from the Chemical Processing Department at HAPO, August 1965, discusses the following: Production Operation; Purex and Redox Operation; Finished Products Operation; Maintenance; Financial Operations; facilities engineering; research; and employee Relations.

5106 (RL-SEP–755-Del.) **Chemical Processing Department monthly report, September 1965.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 22 Oct 1965. 41p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003975. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report, from the Chemical Processing Department at HAPO, September 1965, discusses the following: Production Operation; Purex and Redox Operation; Finished Products Operation; Maintenance; Financial Operations; facilities engineering; research; and employee relations.

5107 (RL-SEP–874-Del.) **Chemical Processing Department monthly report for November 1965.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 22 Dec 1965. 44p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003976. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report, from the Chemical Processing Department at HAPO, November 1965, discusses the following: Production Operation; Purex and Redox Operation; Finished Products Operation; Maintenance; Financial Operations; facilities engineering; research; and employee relations.

5108 (RL-SEP–913-Del.) **Chemical Processing Department monthly report for December 1965.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 21 Jan 1966. 38p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003977. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report, from the Chemical Processing Department at HAPO, December 1965, discusses the following: Production Operation; Purex and Redox Operation; Finished Products Operation; Maintenance; Financial Operations; facilities engineering; research; and employee relations.

5109 (WSRC-RP–92-461) **Recovery of plutonium from solvent wash solutions.** Kyser, E.A. Westinghouse Savannah River Co., Aiken, SC (United States). 31 Mar 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93002254. Source: OSTI; NTIS; INIS; GPO Dep.

A number of potential alternatives to the acid hydrolysis recovery of Pu were investigated. The most promising alternative for short-term use appears to be an anion exchange process that would eliminate the long boiling times and the multiple-pass concentration steps needed with the solvent extraction process because it separates the Pu from the dibutyl phosphate (DBP) while at the same time concentrating the Pu. However, restart of the Primary Recovery Column (PRC) to process this solution would require significant administrative effort. The original boiling recovery by acid hydrolysis followed by solvent extraction is probably the most expedient way to process the Pu-DBP-carbonate solution currently stored in tank 13.5 even with its long processing times and dilute product concentration. Anion exchange of a heat stabilized acidified solution is a more efficient process, but requires restart of the PRC. Extended-boiling acid hydrolysis or anion exchange of a heat stabilized acidified solution provide two well developed alternatives for recovery of the Pu from the tank 13.5 carbonate. Further work defining additional recovery processes is not planned at this time.

0509 Transport, Handling, and Storage

Refer also to citation(s) 5140, 5144, 5659, 6207, 6219, 7008

5110 (DOE/CH/10402–18) **Midwestern High-Level Radioactive Waste Transportation Project: Index of available resources.** Sattler, L.R. Council of State Governments, Lombard, IL (United States). Midwestern Office. May 1992. 38p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC01-89CH10402. Order Number DE93004583. Source: OSTI; NTIS; INIS; GPO Dep.

This is a listing of documents pertaining to radioactive waste transportation.

5111 (DOE/CH/10402–19) **Handbook of high-level radioactive waste transportation.** Sattler, L.R. Council of State Governments, Lombard, IL (United States). Midwestern Office. Oct 1992. 44p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC01-89CH10402. Order Number DE93004584. Source: OSTI; NTIS; INIS; GPO Dep.

The High-Level Radioactive Waste Transportation Handbook serves as a reference to which state officials and members of the

general public may turn for information on radioactive waste transportation and on the federal government's system for transporting this waste under the Civilian Radioactive Waste Management Program. The Handbook condenses and updates information contained in the Midwestern High-Level Radioactive Waste Transportation Primer. It is intended primarily to assist legislators who, in the future, may be called upon to enact legislation pertaining to the transportation of radioactive waste through their jurisdictions. The Handbook is divided into two sections. The first section places the federal government's program for transporting radioactive waste in context. It provides background information on nuclear waste production in the United States and traces the emergence of federal policy for disposing of radioactive waste. The second section covers the history of radioactive waste transportation; summarizes major pieces of legislation pertaining to the transportation of radioactive waste; and provides an overview of the radioactive waste transportation program developed by the US Department of Energy (DOE). To supplement this information, a summary of pertinent federal and state legislation and a glossary of terms are included as appendices, as is a list of publications produced by the Midwestern Office of The Council of State Governments (CSG-MW) as part of the Midwestern High-Level Radioactive Waste Transportation Project.

5112 (DOE/EA–0787) **Environmental Assessment for the shipment of low enriched uranium billets to the United Kingdom from the Hanford Site, Richland, Washington.** USDOE Richland Field Office, WA (United States). Aug 1992. 45p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93002196. Source: OSTI; NTIS; INIS; GPO Dep.

This Environmental Assessment provides the necessary information so that a decision can be made on whether a Finding of No Significant Impact Environmental Impact Statement should be prepared for the proposed action. The proposed action is to transfer 2,592 low enriched uranium billets to the United Kingdom. The billets are currently stored in the 300 Area of the Hanford Site, Richland, Washington. The proposed action would consist of two types of activities: loading and transportation. The loading activities would include placing the billets into the appropriate containers for transportation. The transportation activities would include the tasks required to transport the containers 215 miles (344 km) via highway to the Port of Seattle, Washington, and transfer the containers aboard an ocean cargo vessel for transportation to the United Kingdom. The Department of Energy would only be responsible for conducting the loading activities. The United Kingdom would be responsible for conducting the transportation activities in compliance with all applicable United States and international transportation laws. The tasks associated with the proposed action activities have been performed before and are well defined in terms of requirements and consequences. A risk assessment and a nuclear safety evaluation were performed to address safety issues associated with the proposed action. The risk assessment determined the exposure risk from normal operation and from the maximum credible accident that involves a truck or ship collision followed by a fire that engulfs all the billets in the shipment and the release of the radiological contents of the shipment to the environment. The criticality assessment determined the nuclear safety limits for handling, transporting and storing the shipment under incident-free and accident transport conditions.

5113 (DOE/EH–0291T) **Review of the DOE Packaging and Transportation Safety Program.** Snyder, B.J. (Energy and Management Consultants, Potomac, MD (United States)); Cece, J.M. USDOE Energy Information Administration, Washington, DC (United States). Office of Safety and Quality Assurance. Dec 1992. 50p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93004630. Source: OSTI; NTIS; INIS; GPO Dep.

This report documents the results of a year-long self-assessment of DOE-EH transportation and packaging safety activities. The self-assessment was initiated in September 1991 and concluded in August 1992. The self-assessment identified several significant issues, some of which have been resolved by EH. Also, improvements in the EH program were made during the course of the self-assessment. The report reflects the status of the EH transportation and packaging safety activities at the conclusion of the self-assessment. This report consists of several sections which discuss background, objectives and description of the review. Another section includes summary discussion and key conclusions. Appendix A, Issues, Observations and Recommendations, lists fifteen issues, including appropriate observations and recommendations. A Corrective Action Plan, which documents EH managements resolve to implement the agreed-upon recommendations, is included. The Corrective Action Plan reflects the status of completed and planned actions as of the date of the report.

5114 (NUREG–0383-Vol.1-Rev.15) **Directory of certificates of compliance for radioactive materials packages: Volume 1, Revision 15, Report of NRC approved packages.** Nuclear Regulatory Commission, Washington, DC (United States). Div. of Safeguards and Transportation. Oct 1992. 455p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This directory contains a Report of the US Nuclear Regulatory Commission's Approved Packages (Volume 1), Certificates of Compliance (Volume 2), and a Report of NRC Approved Quality Assurance Programs (Volume 3), for Radioactive Materials Packages effective October 1, 1992. The purpose of this directory is to make available a convenient source of information on packaging which have been approved by the US Nuclear Regulatory Commission. To assist in identifying packaging, an index by Model Number and corresponding Certificate of Compliance Number is included at the front of Volumes 1 and 2. A listing by packaging types is included in the back of Volume 2. An alphabetical listing by Company name is included in the back of Volume 3 for approved QA programs. The reports include a listing of all users of each package-design and approved QA programs prior to the publication date of the directory.

5115 (NUREG–0383-Vol.2-Rev.15) **Directory of certificates of compliance for radioactive materials packages: Volume 2, Revision 15, Certificates of compliance.** Nuclear Regulatory Commission, Washington, DC (United States). Div. of Safeguards and Transportation. Oct 1992. 584p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This directory contains a Report of the US Nuclear Regulatory Commission's Approved Packages (Volume 1), Certificates of Compliance (Volume 2), and a Report of NRC Approved Quality Assurance Programs (Volume 3), for Radioactive Materials Packages effective October 1, 1992. The purpose of this directory is to make available a convenient source of information on packaging which have been approved by the US Nuclear Regulatory Commission. To assist in identifying packaging, an index by Model Number and corresponding Certificate of Compliance Number is included at the front of Volumes 1 and 2. A listing by packaging types is included in the back of Volume 2. An alphabetical listing by Company name is included in the back of Volume 3 for approved QA programs. The reports include a listing of all users of each package-design and approved QA programs prior to the publication date of the directory.

0510 Economic, Industrial, and Business Aspects

Refer also to citation(s) 5140

5116 (DOE/RW–0380P) **Quarterly report on program cost and schedule, fourth quarter FY 1992.** USDOE Office of Civilian Radioactive Waste Management, Washington, DC (United States). [1992]. 30p. Sponsored by USDOE, Washington, DC (United States). Source: OSTI (Free of Charge).

This report is intended to provide a summary of the cost and schedule perform for the Civilian Radioactive Waste Management Program. Historical and current cost profiles (extracted from the DOE Financial Information System) are presented for each of the major program elements. Also included in this report are the program schedule baseline, the status of near-term program milestones and the status of the Nuclear Waste Fund revenues and disbursements. This report includes data through September 1992.

0520 Waste Management

Refer also to citation(s) 5022, 5057, 5071, 5076, 5092, 5097, 5099, 5100, 5103, 5104, 5105, 5106, 5107, 5108, 5116, 5184, 5187, 5188, 5189, 5190, 5193, 5199, 5201, 5208, 5515, 5765, 5832, 5833, 6087, 6243, 6244, 6285, 6527, 6557, 6690, 7483

5117 (BfS-ET–12/92) **Disposal of radioactive wastes. Proceedings.** Kugel, K.; Brennecke, P.; Giller, H. (eds.). Bundesamt fuer Strahlenschutz, Braunschweig (Germany). Fachbereich Nukleare Entsorgung und Transport. Jun 1992. 140p. (In German). (CONF-9111277–: Information meeting 'Disposal of radioactive wastes', Berlin (Germany), 25-26 Nov 1991). Order Number DE93742804. Source: OSTI; NTIS (US Sales Only); INIS.

The meeting which was organized by Bundesamt fuer Strahlenschutz and took place on November 25 and 26, 1991 in Berlin informed the plant owners liable to delivery, the nuclear waste conditioners, and the nuclear licensing and supervisory boards in the five new provinces of unified Germany on the disposal of radioactive wastes. Emphasis was placed on the radioactive waste acceptance requirements, waste package quality control, safety aspects relevant to the Morsleben repository, and on the conditioning and intermediate storage of radioactive wastes. (BBR).

5118 (BfS-ET–12/92, pp. 7-12) **Repository projects in the Federal Republic of Germany - a progress report.** Thomauske, B.R. (Bundesamt fuer Strahlenschutz, Salzgitter (Germany)). Bundesamt fuer Strahlenschutz, Braunschweig (Germany). Fachbereich Nukleare Entsorgung und Transport. Jun 1992. (In German). (CONF-9111277–: Information meeting 'Disposal of radioactive wastes', Berlin (Germany), 25-26 Nov 1991). In *Disposal of radioactive wastes. Proceedings.* 140p. Order Number DE93742804. Source: OSTI; NTIS (US Sales Only); INIS.

The Konrad ore mine and the Gorleben salt dome are currently tested for their suitability as repositories for radioactive wastes in the Federal Republic of Germany. The existing Morsleben repository which has been in charge of Bundesamt fuer Strahlenschutz since the unification of Germany on October 3, 1990 is being improved and modernized at the same time. The report discusses the state of the Gorleben project, the problems which have been delaying the advanced Konrad licensing and planning procedures, and the future of the Morsleben repository. (orig.).

5119 (BfS-ET–12/92, pp. 13-27) **Radioactive wastes - inventories and classification.** Brennecke, P. (Bundesamt fuer Strahlenschutz, Salzgitter (Germany)); Hollmann, A. Bundesamt fuer Strahlenschutz, Braunschweig (Germany). Fachbereich Nukleare Entsorgung und Transport. Jun 1992. (In German). (CONF-9111277–: Information meeting 'Disposal of radioactive wastes', Berlin (Germany), 25-26 Nov 1991). In *Disposal of radioactive wastes. Proceedings.* 140p. Order Number DE93742804. Source: OSTI; NTIS (US Sales Only); INIS.

A survey is given of the origins, types, conditioning, inventories, and expected abundance of radioactive wastes in the future in the Federal Republic of Germany. The Federal Government's radioactive waste disposal scheme provides that radioactive wastes be buried in deep geological formations which are expected to ensure a maintenance-free, unlimited and safe disposal without intentional excavation of the wastes at a later date. (orig./BBR).

5120 (BfS-ET–12/92, pp. 29-42) **Waste acceptance requirements.** Brennecke, P. (Bundesamt fuer Strahlenschutz, Salzgitter (Germany)); Noack, W. Bundesamt fuer Strahlenschutz, Braunschweig (Germany). Fachbereich Nukleare Entsorgung und Transport. Jun 1992. (In German). (CONF-9111277–: Information meeting 'Disposal of radioactive wastes', Berlin (Germany), 25-26 Nov 1991). In *Disposal of radioactive wastes. Proceedings.* 140p. Order Number DE93742804. Source: OSTI; NTIS (US Sales Only); INIS.

The safety criteria established for repositories (geological condition of sites, geotechnical layout of mines, properties of the radioactive wastes) create special waste acceptance requirements to be observed by plant owners liable to delivery and by the radioactive waste conditioners. The waste acceptance requirements thus have a direct influence on the conditioning, i.e. the processing and packaging of radioactive wastes. The individual waste acceptance requirements applicable to the Morsleben repository and the Konrad and Gorleben projects are elucidated. (BBR).

5121 (BfS-ET–12/92, pp. 43-59) **The ERAM safety analysis.** Mueller, W. (Gesellschaft fuer Reaktorsicherheit mbH, Koeln (Germany)). Bundesamt fuer Strahlenschutz, Braunschweig (Germany). Fachbereich Nukleare Entsorgung und Transport. Jun 1992. (In German). (CONF-9111277–: Information meeting 'Disposal of radioactive wastes', Berlin (Germany), 25-26 Nov 1991). In *Disposal of radioactive wastes. Proceedings.* 140p. Order Number DE93742804. Source: OSTI; NTIS (US Sales Only); INIS.

The ERAM safety analysis (ERAM - Endlager fuer Radioaktive Abfaelle Morsleben/Morsleben radioactive waste repository) comprised a site characterization, a characterization of the buried radioactive wastes, an evaluation of the operational safety and radiation exposure, a geological site characterization, and an evaluation of the long-time safety. (BBR).

5122 (BfS-ET–12/92, pp. 61-72) **Waste package quality control - the Konrad ore mine and the Morsleben repository.** Martens, B.R. (Bundesamt fuer Strahlenschutz, Salzgitter (Germany)). Bundesamt fuer Strahlenschutz, Braunschweig (Germany). Fachbereich Nukleare Entsorgung und Transport. Jun 1992. (In German). (CONF-9111277–: Information meeting 'Disposal of radioactive wastes', Berlin (Germany), 25-26 Nov 1991). In *Disposal of radioactive wastes. Proceedings.* 140p. Order Number DE93742804. Source: OSTI; NTIS (US Sales Only); INIS.

Details are given about the methods which are currently applied to ensure the observance of waste acceptance conditions in the framework of the waste package quality control procedures to be undergone by radioactive wastes intended for storage in the Morsleben repository and in the Konrad ore mine. The control procedure applied in the former German Democratic Republic is briefly discussed because licenses, permits and approvals granted in accordance with the environmental framework law of July 1st, 1990 in the former German Democratic Republic or given in accordance with para. 57 a of the Atomic Energy Law remain valid within certain limits. (orig./BBR).

5123 (BfS-ET–12/92, pp. 73-97) **Registration and delivery of radioactive wastes.** Giller, H. (Bundesamt fuer Strahlenschutz, Salzgitter (Germany)). Bundesamt fuer Strahlenschutz, Braunschweig (Germany). Fachbereich Nukleare Entsorgung und Transport. Jun 1992. (In German). (CONF-9111277–: Information meeting 'Disposal of radioactive wastes', Berlin (Germany), 25-26 Nov 1991). In *Disposal of radioactive wastes. Proceedings.* 140p. Order Number DE93742804. Source: OSTI; NTIS (US Sales Only); INIS.

Registration and delivery by the plant owners and delivering companies are links in the chain of a regular radioactive waste disposal. The radioactive waste registration, transport and final disposal system developed for ERAM (Endlager fuer Radioaktive Abfaelle Morsleben/Morsleben radioactive waste repository) was applied until the registration and final disposal of radioactive wastes at the Morsleben salt mine were provisionally discontinued on February 25, 1991. The call-in system planned for the Salzgitter ore mine repository Konrad accompanies radioactive wastes from waste package registration to waste package delivery to the repository. (BBR).

5124 (BfS-ET–12/92, pp. 99-114) **Conditioning and intermediate storage of radioactive wastes.** Rittscher, D. (Gesellschaft fuer Nuklear-Service mbH (GNS), Essen (Germany)). Bundesamt fuer Strahlenschutz, Braunschweig (Germany). Fachbereich Nukleare Entsorgung und Transport. Jun 1992. (In German). (CONF-9111277–: Information meeting 'Disposal of radioactive wastes', Berlin (Germany), 25-26 Nov 1991). In *Disposal of radioactive wastes. Proceedings.* 140p. Order Number DE93742804. Source: OSTI; NTIS (US Sales Only); INIS.

Details are given about the tasks of and services by Gesellschaft fuer Nuklear-Service mbH (GNS) in the framework of the conditioning and intermediate storage of radioactive wastes. (BBR).

5125 (BfS-ET–12/92, pp. 115-138) **Experiences gained in the conditioning of radioactive wastes from regional depots by**

example of Kernforschungszentrum Karlsruhe, and recommendations for the establishment of regional depots in the new Federal States of unified Germany. Pfeifer, W. (Kernforschungszentrum Karlsruhe GmbH (Germany). Hauptabt. Dekontaminationsbetriebe). Bundesamt fuer Strahlenschutz, Braunschweig (Germany). Fachbereich Nukleare Entsorgung und Transport. Jun 1992. (In German). (CONF-9111277–: Information meeting 'Disposal of radioactive wastes', Berlin (Germany), 25-26 Nov 1991). In *Disposal of radioactive wastes. Proceedings.* 140p. Order Number DE93742804. Source: OSTI; NTIS (US Sales Only); INIS.

Details are given about radioactive waste management and radioactive waste management fundamentals as well as about the respective methods applied by the Baden-Wuerttemberg radioacive waste depot. The waste treatment, quality assurance and internal inspection methods applied by Hauptabteilung Dekontaminationsbetriebe (HDB), Kernforschungszentrum Karlsruhe (KfK) are described, and recommendations are given for the establishment of regional depots in the new provinces of the Federal Republic of Germany. These recommendations which are based on Western German standards before unification suggest regional depots with combined administrative systems which watch over the depot use and charges, the foundation of a waste management association responsible for the disposal, transport, intermediate storage and conditioning of radioactive wastes in the new provinces, and the establishment of a facility to be run by the proposed waste management association for the intermediate storage of conditioned waste packages intended for final disposal. (orig.).

5126 (CONF-921029–8) **The US Environmental Protection Agency's "contained-in" policy and its impact on groundwater issues at Oak Ridge National Laboratory.** Schrof, C.A.; Bonine, T.M.; Greer, J.K. Jr. Oak Ridge National Lab., TN (United States). [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Annual Department of Energy model conference on waste management and environmental restoration; Oak Ridge, TN (United States); 19-22 Oct 1992. Order Number DE93001714. Source: OSTI; NTIS; GPO Dep.

This report discusses the contained-in policy governing the regulation of hazardous wastes. The policy has evolved as an internal US Environmental Protection Agency (EPA) policy that essentially allows the Agency to regulate materials that are outside the scope of the Resource Conservation and Recovery Act's (RCRA) jurisdiction. The contained-in policy was originally developed to cover soil and groundwater issues, but the policy has evolved over time to cover other issues.

5127 (CONF-921029–13) **The role of the observational approach in RI planning: WAG 5 case study.** Brill, A.K. (Ogden Environmental and Energy Services, Oak Ridge, TN (United States)); Kuhaida, A.J. Jr. Oak Ridge National Lab., TN (United States). Oct 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Annual Department of Energy model conference on waste management and environmental restoration; Oak Ridge, TN (United States); 19-22 Oct 1992. Order Number DE93003025. Source: OSTI; NTIS; INIS; GPO Dep.

A Remedial Investigation (RI) Plan was developed for the Oak Ridge National Laboratory (ORNL) Waste Area Grouping (WAG) 5 in March 1988 and submitted to the Environmental Protection Agency (EPA) Region IV and the State of Tennessee for review and approval. The observational approach was evaluated by the ORNL Environmental Restoration (ER) Program and accepted by EPA as an accelerated and cost-effective approach to the RI/Feasibility Study (FS) process for remediation of WAG 5. The traditional approach used in preparing the 1988 RI Plan focused on data completeness, included a typical range of RI data-gathering activities for determining the nature and extent of contamination at WAG 5, and used multiple iterations of sampling activities to deal with uncertainties without consideration of potential deviations. In fall 1991, a revised Field Sampling Plan (FSP) was developed that used the observational approach to integrate site characterization with site remediation needs. This approach recognized the uncertainties of site characterization/remedial planning and developed contingency plans for dealing with them. The observational approach emphasizes data sufficiency to support remedial planning decisions for WAG 5.

5128 (DOE/CH/10378–10) **RE/SPEC Inc. technical support to the Repository Technology Program: Summary of activities for September 1, 1988–June 30, 1992.** Wagner, R.A. RE/SPEC, Inc., Rapid City, SD (United States). Jun 1992. 56p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-89CH10378. Order Number DE93006069. Source: OSTI; NTIS; INIS; GPO Dep.

This report presents a summary of all RE/SPEC Inc. technical support activities to the Repository Technology Program (RTP) from September 1, 1988, through June 30, 1992. The RE/SPEC Inc. activities are grouped into the following categories: project management, project quality assurance (QA), performance assessment (PA), support of the Office of Civilian Radioactive Waste Management (OCRWM) through technical reviews and general assistance, participation in the Department of Energy (DOE) International Program, and code evaluation and documentation.

5129 (DOE/EA–0594) **Environmental assessment for the scintillation vial crusher TA-54, Area L, Los Alamos National Laboratory, Los Alamos, New Mexico.** Los Alamos National Lab., NM (United States). Jul 1992. 24p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93002211. Source: OSTI; NTIS; GPO Dep.

Research and development projects conducted at the Los Alamos National Laboratory produce scintillation vials as waste from normal operations. These vials contain radioisotopes such as tritium, carbon-14, and isotopes of transuranic elements such as americium-241, plutonium-238 and -239. The scintillation fluids contain some solvents defined as hazardous waste. The vials are thus classed as mixed waste under the Resource Conservation and Recovery Act (RCRA). The Laboratory has in storage some 520 drums of stored vials and is accumulating some 70 to 140 more drums annually. The drained vial fragments can be disposed of at TA-54 as low-level radioactive waste (LLW). The bulked liquid will be stored at TA-54 as RCRA mixed waste until treatment/disposal options are developed. Other waste from the vial crushing operation will also be stored at TA-54 as mixed waste. By operating the scintillation vial crusher, the storage space needed for this RCRA mixed waste stream can be reduced to about 5% of that currently being used. The other 95% will be vial fragments that can be disposed immediately as LLW.

5130 (DOE/EA–0809) **Thermocouple tree system installation and operation in non-leaking ferrocyanide tanks, Hanford Site, Richland, Washington: Environmental assessment.** US-DOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States). Sep 1992. 26p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93001944. Source: OSTI; NTIS; INIS; GPO Dep.

The US Department of Energy (DOE) has prepared an environmental assessment (EA), DOE/EA-0809, to assess environmental impacts associated with installing and operating thermocouple tree (TCT) systems in 11 non-leaking Hanford Site single-shell ferracyanide-containing high-level waste tanks. The objective is to improve DOE's knowledge of ferracyanide waste temperatures, including the possible presence of discrete localized areas of elevated temperatures within the tanks ("hot spots"), by providing additional temperature monitoring instrumentation. DOE needs to take action to gain a better understanding of the potential for hot spots to exist within the tanks that could result in an explosion or release of radioactive material, and to better understand potential reactive behavior of the farrocyanide waste in order to resolve current Unreviewed Safety Questions declared for these tanks. Based on the evaluation in the EA, DOE has determined that the proposed action is not a major Federal action significantly affecting the quality of the human environment within the meaning of the National Environmental Policy Act (NE PA) of 1969. Therefore, the preparation of an environmental impact statement is not required, and DOE is issuing this Finding of No Significant Impact.

5131 (DOE/EH–0289T) **Report on the EH special review of occupational safety and health programs for the Hanford high-level waste tanks.** USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (United States). Nov 1992. 126p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93003763. Source: OSTI; NTIS; GPO Dep.

This report documents a review of the occupational safety and health programs currently in effect at the tank farms located at the Hanford Reservation in Washington State. The review was undertaken by the Office of Environment, Safety and Health (EH) at the request of the Office of Environmental Restoration and Waste Management (EM) to determine whether issues important to worker safety and health have been properly identified, prioritized, and resolved. To carry out this task, four categories of safety and health activities were reviewed. The first category involved examination of management issues associated with the toxicity, flammability, and explosivity of gases and vapors generated by wastes. The second focused on waste tank characterization and technology programs that have been initiated at Hanford to identify, characterize and mitigate hazards associated with tanks generating hydrogen or containing ferrocyanides or organic compounds. The third evaluated worker safety and health programs necessary to support hazardous waste site operations it the tank farms. The fourth dealt with interim corrective actions currently in place, pending full implementation of site-specific safety and health programs to address waste vapor toxicity, flammability, and explosivity hazards.

5132 (DOE/EM–0095P) **Independent technical review of the Hanford Tank Farm Operations.** USDOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States). Jul 1992. 188p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93001758. Source: OSTI; NTIS; INIS; GPO Dep.

The Independent Technical Assessment of the Hanford Tank Farm Operations was commissioned by the Assistant Secretary for Environmental Restoration and Waste Management on November 1, 1991. The Independent Technical Assessment team conducted on-site interviews and inspections during the following periods: November 18 to 22,1991; April 13 to 17; and April 27 to May 1, 1992. Westinghouse Hanford Company is the management and operating contractor for the Department of Energy at the Hanford site. The Hanford Tank Farm Operations consists of 177 underground storage tanks containing 61 million gallons of high-level radioactive mixed wastes from the chemical reprocessing of nuclear fuel. The Tank Farm Operations also includes associated transfer lines, ancillary equipment, and instrumentation. The Independent Technical Assessment of the Hanford Tank Farm Operations builds upon the prior assessments of the Hanford Waste Vitrification System and the Hanford Site Tank Waste Disposal Strategy.The objective of this technical assessment was to determine whether an integrated and sound program exists to manage the tank-waste storage and tankfarm operations consistent with the Assistant Secretary for Environmental Restoration and Waste Management's guidance of overall risk minimization. The scope of this review includes the organization, management, operation, planning, facilities, and mitigation of the safety-concerns of the Hanford Tank Waste Remediation System. The assessments presented in the body of this report are based on the detailed observations discussed in the appendices. When the assessments use the term "Hanford" as an organizational body it means DOE-RL and Westinghouse Hanford Company as a minimum, and in many instances all of the stake holders for the Hanford site.

5133 (DOE/LLW–152) **1991 State-by-state assessment of low-level radioactive wastes received at commercial disposal sites: National Low-Level Waste Management Program.** Fuchs, R.L.; Culbertson-Arendts, K. EG and G Idaho, Inc., Idaho Falls, ID (United States). National Low-Level Waste Management Program. Sep 1992. 146p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (INEL/MISC–92070). Order Number DE93005068. Source: OSTI; NTIS; INIS; GPO Dep.

Each year the National Low-Level Waste Management Program publishes a state-by-state assessment report. This report provides both national and state-specific disposal data on low-level radioactive waste commercially disposed of in the United States. Data in this report are categorized according to disposal site, generator category, waste class, volumes, and radionuclide activity. Included in this report are tables showing the distribution of waste by state for 1991 and a comparison of waste volumes and radioactivity by state for 1987 through 1991; also included is a list of all commercial nuclear power reactors in the United States as of December 31, 1991. This report distinguishes between low-level radioactive waste shipped directly for disposal by generators and that which was handled by an intermediary, a reporting change introduced in the 1988 state-by-state report.

5134 (DOE/OSTI–3406(Suppl.3)(Add.1)) **Yucca Mountain Site characterization project bibliography, January–June 1992: An Update: Supplement 3, Addendum 1.** USDOE Office of Scientific and Technical Information, Oak Ridge, TN (United States). Sep 1992. 38p. Sponsored by USDOE, Washington, DC (United States). Order Number DE92016339. Source: OSTI; NTIS; INIS; GPO Dep.

Following a reorganization of the Office of Civilian Radioactive Waste Management in 1990, the Yucca Mountain Project was renamed Yucca Mountain Site Characterization Project. The title of this bibliography was also changed to Yucca Mountain Site Characterization Project Bibliography. Prior to August 5, 1988, this project was called the Nevada Nuclear Waste Storage Investigations. This bibliography contains information on this ongoing project that was added to the Department of Energy's Energy Science and Technology Database from January 1, 1992, through June 30, 1992. The bibliography is categorized by principal project participating organization. Participant-sponsored subcontractor resorts, papers, and articles are included in the sponsoring organization's list. Another section contains information about publications on the Energy Science and Technology Database that were not sponsored by the project but have some relevance to it.

5135 (DOE/RL–90-12-Rev.1) **Request for interim approval to operate 218-E-12B Trench 94 as a chemical waste landfill for disposal of polychlorinated biphenyl wastes in submarine reactor compartments: Revision 1.** USDOE Richland Operations Office, WA (United States). Feb 1992. 142p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93002044. Source: OSTI; NTIS; GPO Dep.

This request is submitted to seek interim approval to operate a chemical waste landfill for the disposal of polychlorinated biphenyl (PCB) waste. Interim approval is requested for a period not to exceed 5 years. This request covers only the disposal of small quantities of solid PCB waste contained in decommissioned, defueled submarine reactor compartments (SRC). In addition, the request applies only to disposal of this waste in Trench 94 of the 218-E-12B Burial Ground (Trench 94) in the 200 East Area of the US Department of Energy (DOE) Hanford Site. Because Trench 94 is being used for disposal of mixed waste, it is subject to applicable requirements for dangerous and hazardous waste landfills under WAC 173-303 and 40 CFR 265, respectively. Operation of a chemical waste landfill for disposal of PCB waste is subject to the TSCA and must comply with the TSCA regulations of 40 CFR 761. This request demonstrates how Trench 94 will be operated to comply with the applicable TSCA requirements, specifically the requirements for chemical waste landfills under 40 CFR 761.75.

5136 (DOE/RL–92-21) **Hanford Site physical separations CERCLA treatability test plan.** USDOE Richland Field Office, WA (United States). Mar 1992. 39p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93002048. Source: OSTI; NTIS; INIS; GPO Dep.

This test plan describes specifications, responsibilities, and general procedures to be followed to conduct a physical separations soil treatability test in the North Process Pond of the 300-FF-1 Operable Unit at the Hanford Site, Washington. The objective of this test is to evaluate the use of physical separation systems as a means of concentrating chemical and radioactive contaminants into fine soil fractions and thereby minimizing waste volumes. If successful the technology could be applied to clean up millions of cubic meters of contaminated soils in waste sites at Hanford and other sites. It is not the intent of this test to remove contaminated materials from the fine soils. Physical separation is a simple and

comparatively low cost technology to potentially achieve a significant reduction in the volume of contaminated soils. Organic contaminants are expected to be insignificant for the 300-FF-I Operable Unit test, and further removal of metals and radioactive contaminants from the fine fraction of soils will require secondary treatment such as chemical extraction, electromagnetic separation, or other technologies. Additional investigations/testing are recommended to assess the economic and technical feasibility of applying secondary treatment technologies, but are not within the scope of this test. This plan provides guidance and specifications for the treatability test to be conducted as a service contract. More detailed instructions and procedures will be provided as part of the vendors (sellers) proposal. The procedures will be approved by Westinghouse Hanford Company (Westinghouse Hanford) and finalized by the seller prior to initiating the test.

5137 (DOE/RW–0006-Rev.8) **Integrated Data Base for 1992: US spent fuel and radioactive waste inventories, projections, and characteristics: Revision 8.** Oak Ridge National Lab., TN (United States). Oct 1992. 341p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. (ORNL/M–2524). Source: INIS; OSTI (Free of Charge).

The Integrated Data Base (IDB) Program has compiled current data on inventories and characteristics of commercial spent fuel and both commercial and US government-owned radioactive wastes through December 31, 1991. These data are based on the most reliable information available from government sources, the open literature, technical reports, and direct contacts. The information forecasted is consistent with the latest US Department of Energy/Energy Information Administration (DOE/EIA) projections of US commercial nuclear power growth and the expected DOE-related and private industrial and institutional (I/I) activities. The radioactive materials considered, on a chapter-by-chapter basis, are spent nuclear fuel, high-level waste, transuranic waste, low-level waste, commercial uranium mill tailings, environmental restoration wastes, commercial reactor and fuel cycle facility decommissioning wastes, and mixed (hazardous and radioactive) low-level waste. For most of these categories, current and projected inventories are given through the year 2030, and the radioactivity and thermal power are calculated based on reported or estimated isotopic compositions. In addition, characteristics and current inventories are reported for miscellaneous radioactive materials that may require geologic disposal.

5138 (DOE-RW–89.069) **The geological, geochemical, topographical and hydrogeological characteristics of the Broubster natural analogue site, Caithness.** Ball, T.K. (British Geological Survey, Keyworth (United Kingdom)); Milodowski, A.E. Department of the Environment, London (United Kingdom). Her Majesty's Inspectorate of Pollution. Jun 1989. [206] Contract PECD–7/9/367;WE/89/37. Order Number DE93609552. Source: OSTI; NTIS (US Sales Only); INIS.

One of the four natural analogue sites chosen for investigation by the British Geological Survey is the uranium mineralisation at Broubster, Caithness, Scotland. Naturally occurring uranium has been leached from a thin mineralised limestone horizon and has been carried by groundwater flow into a peat bog about 100m away. This process has probably been going on for at least 5000 years. Standard surveying, hydrogeological and geochemical methods have been applied in the investigation and analysis of the area. Selected samples of the mineralisation, peat soils and associated groundwaters have been examined in detail. This report summarises the main findings accumulated since 1968 when the site was first discovered, and provides a useful information base for further modelling work. (author).

5139 (DOE/RW/00264–T2) **Final report on the public involvement process phase 1, Monitored Retrievable Storage Facility Feasibility Study.** Moore, L.; Shanteau, C. Western Network, Santa Fe, NM (United States). Dec 1992. 193p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG01-92RW00264. Order Number DE93005501. Source: OSTI; NTIS; INIS; GPO Dep.

This report summarizes the pubic involvement component of Phase 1 of the Monitored Retrievable Storage Facility (NM) Feasibility Study in San Juan County, Utah. Part of this summary includes background information on the federal effort to locate a voluntary site for temporary storage of nuclear waste, how San Juan County came to be involved, and a profile of the county. The heart of the report, however, summarizes the activities within the public involvement process, and the issues raised in those various forums. The authors have made every effort to reflect accurately and thoroughly all the concerns and suggestions expressed to us during the five month process. We hope that this report itself is a successful model of partnership with the citizens of the county – the same kind of partnership the county is seeking to develop with its constituents. Finally, this report offers some suggestions to both county officials and residents alike. These suggestions concern how decision-making about the county's future can be done by a partnership of informed citizens and listening decision-makers. In the Appendix are materials relating to the public involvement process in San Juan County.

5140 (DOE/RW–0363-TG) **Science, society, and America's nuclear waste: Unit 3, The Nuclear Waste Policy Act: Teacher guide.** USDOE Office of Civilian Radioactive Waste Management, Washington, DC (United States). [1992]. 83p. Sponsored by USDOE, Washington, DC (United States). Source: OSTI (Free of Charge); INIS.

This teachers guide is unit 3, the nuclear waste policy act, in a four-unit secondary curriculum. It is intended to provide information about scientific and societal issues related to the management of spent nuclear fuel from generation of electricity at nuclear powerplants and high-level radioactive waste from US national defense activities. The curriculum, supporting classroom activities, and teaching materials present a brief discussion of energy and electricity generation, including that produced at nuclear power plants; information on sources, amounts, location, and characteristics of spent nuclear fuel and high-level radioactive waste; sources, types and effects of radiation; US policy for managing and disposing of spent nuclear fuel and high-level radioactive waste and what other countries are doing; and the components of the nuclear waste management system.

5141 (DOE/WIPP–92-050) **Waste Handling Shaft concrete liner degradation conclusions and recommendations.** Westinghouse Electric Corp., Carlsbad, NM (United States). Waste Isolation Div. Oct 1992. 213p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-86AL31950. Order Number DE93004293. Source: OSTI; NTIS; INIS; GPO Dep.

The primary function of the Waste Handling Shaft (WHS) at the Waste Isolation Pilot Plant (WIPP) is to permit the transfer of radioactive waste from the surface waste handling building to the underground storage area. It also serves as an intake shaft for small volumes of air during normal storage operations and as an emergency escape route. Part of the construction was the placement of a concrete liner and steel reinforced key in 1984. During a routine shaft inspection in May 1990, some degradation of the WHS concrete liner was observed between the depths of 800 and 900 feet below the ground surface. Detailed investigations of the liner had been carried out by Sandia National Laboratories and by Westinghouse Electric Corporation Waste Isolation Division (WID) through Lankard Materials Laboratory. Observations, reports, and data support the conclusion that the concrete degradation, resulting from attack by chemically aggressive brine, is a localized phenomena. It is the opinion of the WID that the degradation is not considered an immediate or near term concern; this is supported by technical experts. WID recommendations have been made which, when implemented, will ensure an extended liner life. Based on the current assessment of available data and the proposed shaft liner monitoring program described in this report, it is reasonable to assume that the operational life of the concrete shaft liner can safely support the 25-year life of the WIPP. Analysis of data indicates that degradation of the shaft's concrete liner is attributed to chemically aggressive brine seeping through construction joints and shrinkage cracks from behind the liner in and around the 834-foot depth. Chemical and mechanical components of concrete degradation have been identified. Chemical attack is comprised of several stages of concrete alteration. The other component, mechanical degradation, results from the expansive forces of crystals forming in the concrete pore space.

5142 (DPW–53-661) **Report on visit to Argonne Laboratory, March 8–9, 1953.** Davis, M.W. Jr.; Jenkins, W.A. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 8 Apr 1953. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–258). Order Number DE93002724. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Short communication. SAVANNAH RIVER PLANT/solvent extraction; RADIOACTIVE WASTES/reprocessing; TRAVEL; CHLORINATED ALIPHATIC HYDROCARBONS; CARBON TETRACHLORIDE; MATERIAL SUBSTITUTION; EMULSIONS; MIXER-SETTLERS; REPROCESSING; RADIOACTIVE WASTE PROCESSING

5143 (ES/ER/TM–41) **Characterization summary report for pond waste commercial disposal project: Environmental Restoration Program.** Barkenbus, B.D.; Grumski, J.T.; Sams, T.L. Oak Ridge National Lab., TN (United States). Aug 1992. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93000554. Source: OSTI; NTIS; GPO Dep.

This report is prepared to summarize information on the existing sampling and analysis results for the K-1407B and K-1407C ponds holding basins for wastes received from the Oak Ridge K-25 Plant. The purpose of the document is to compare the existing data to commercial disposal facility criteria so that off-site disposal options for pond waste drums can be examined. There are ~45,795 drums of stabilized sludge and ~31,954 drums of raw sludge at the Oak Ridge K-25 Site. There have been corrosion and storage problems associated with these drums. The US Department of Energy would like to transport all waste drums that meet regulatory requirements to a commercial disposal facility. This report describes waste characterization and classifications.

5144 (GRS–91) **Konrad transport study: Safety analysis of the transportation of radioactive waste to the Konrad waste disposal site.** Lange, F.; Gruendler, D.; Schwarz, G. Gesellschaft fuer Reaktorsicherheit mbH (GRS), Koeln (Germany). May 1992. 143p. Order Number DE93744379. Source: OSTI; NTIS (US Sales Only); INIS.

For the purpose of the study the anticipated waste transport volume and the waste properties were analysed in detail. This included information on the transport containers, waste product properties, activity inventories and local dose rates of the waste packages being transported. The envisaged practical implementation, i.e. the transport arrangements including shunting operations at the Braunschweig marshalling yard and the Beddingen interchange station, were also included. The two shipping scenarios 100% transportation by rail and 80% transportation by rail, 20% by road, which could be considered to bound the real conditions, were analysed. The relevant transport regulations contain the requirements to be met by the transport of shipping units carrying radioactive waste. In addition, the "Konrad preliminary waste acceptance criteria" contain activity limits for waste packages being disposed of in conjunction with further requirements relating to the properties of waste products and waste containers. (orig./DG).

5145 (GSF–3/92) **Formation and fate of gases in the caverns of a repository in salt rock. Status report.** Mueller, W. (Gesellschaft fuer Reaktorsicherheit mbH, Koeln (Germany)); Morlock, G.; Gronemeyer, C. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Bundesministerium fuer Forschung und Technologie, Bonn (Germany). 1992. 168p. (In German). Contract BMFT KWA 5901. (GSF-TL–2/92). Order Number DE93742646. Source: OSTI; NTIS (US Sales Only); INIS.

The report summarizes the knowledge avaible today of the mechanisms governing the formation and transport of gases in a salt mine repository for radioactive wastes. The work under review deals with the formation of gases-by way of radiolysis, corrosion, microbial degradation, thermally induced or primary gas generation - and analyses the efficiency of predicting and modelling the gas generation mechanisms in terms of the role of parameters involved, and accuracy. Existing gaps in available knowledge are shown and defined in terms of significance, leading to an analysis of interdependencies between the various mechanisms and to a statement concerning the necessity of establishing materials balances. (orig./EF).

5146 (GSF–32/90) **EMOS: Program package for the long-term safety analysis of a repository for radioactive waste, version 4.** Storck, R. (GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Braunschweig (Germany). Inst. fuer Tieflagerung); Buhmann, D.; Hirsekorn, R.P.; Nies, A.; Rausch, H. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Sep 1990. 385p. (In German). Contract BMFT KWA 54086. (GSF-TL–8/92). Order Number DE93744280. Source: OSTI; NTIS (US Sales Only); INIS.

Model calculations were performed with the EMOS/REPOS code describing the release of radionuclides from a salt formation, and radionuclide transport in the cap rock was computed separately for one-dimensional or multidimensional dispersion using the SWIFT code. The EMOS code, however, is basically designed so as to allow both the calculation of radionuclide release from a mine opening in a salt formation with the REPOS code, and the subsequent disperson processes in the cap rock and the resulting radiation exposure in the biosphere, with the help of several other modules. These modules have been developed and implemented. Furthermore, the EMOS code was provided with a Monte-Carlo frame, in order to take into account the range of variation of input data, referring to the mine opening, the cap rock, and the biosphere. (orig.).

5147 (GSF–35/91) **Dam construction in salt rock. Test schedule.** Stockmann, N. (GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Inst. fuer Tieflagerung, Braunschweig (Germany)); Beinlich, A.; Flach, D.; Jockwer, N.; Klarr, K.; Krogmann, P.; Miehe, R.; Schmidt, M.W.; Schwaegermann, H.F.; Walter, F.; Yaramanci, UGSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Nov 1991. 332p. (In German). Contract BMFT KWA 5603A6;EC F12W-CT90-0068(B). (GSF-TL–25/91). Order Number DE93744279. Source: OSTI; NTIS (US Sales Only); INIS.

Barriers are a major component of the safety concept for the Gorleben repository. The construction and performance of dams are currently tested within the framework of a project carried out in the Asse salt mine. A measuring programme has been established to give evidence of the sealing capacities of a barrier consisting of an abatement, long-term sealing material, and a hydraulic sealing system. Tests are to be made to verify the barrier's performance for shorter of long time periods (up to about 500 years). The tests are assisted by computed models established for the project. The long-term safety aspects to be studied include such conditions as permeability changes due to mechanical impacts, circulation conditions at the roadside, and the serviceable life and efficiency of the sealing components. (DG).

5148 (INIS-mf–13387, pp. 811-832) **Treatment of uranium tailings vis-a-vis radium containment.** Markose, P.M. (Uranium Corp. of India, Jaduguda (India). Health Physics Unit); Eappen, K.P.; Raghavayya, M.; Pillai, K.C. Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences. 1991. [653] (CONF-8912172–: International symposium on uranium technology, Bombay (India), 13 Dec 1989). In *Proceedings of the international symposium on uranium technology [held at Bombay during 13-15 Dec 1989]. V. 2.* Order Number DE93608801. Source: OSTI; NTIS (US Sales Only); INIS.

One of the essential requirements of operations in a uranium mine-mill complex is the treatment and containment of tailings so that their discharge to the environment meets the accepted release standards. This paper reviews experience in the work related to the containment of radium in tailings. Lime treated tailings effluents carry dissolved radium to the extent of 6000 to 8000 $Bq.M^{-3}$, which is undesirable from the point of view of its environmental impact. A contact bed process for treating this effluent was developed, achieving more than 90% decontamination. The merits and demerits of the method are discussed. Other options considered and trials carried out to reduce the dissolved radium in tailings are also discussed. A recent approach in the treatment of tailings is the extraction of radium from the tailings in an attempt to make it intrinsically safe. About 90% of radium could be extracted using ferric

chloride in hydrochloric acid solution. Various implications of this approach to the containment of radium are discussed in the paper. The paper also indicates incidental containment of other toxins in the tailings, like manganese. (author). 14 refs., 3 figs., 6 tabs.

5149 (INIS-mf-14098) **Studies of the behaviour of backfill taking into account the interaction between rock and backfill, and other sealing components at a saline repository. Final report.** Diekmann, N.; Stuehrenberg, D. Bundesanstalt fuer Geowissenschaften und Rohstoffe (BGR), Hannover (Germany); Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Sep 1991 74p. (In German). Contract BMFT KWA5801. Order Number DE93744914. Source: OSTI; NTIS (US Sales Only); INIS.

According to the present planning level of the designed Gorleben repository, the salt produced by opening up cavities for ultimate disposal will be used as salt fines for backfilling residual cavities after radioactive waste emplacement. The essential function properties of the backfill - compaction and permeability - were studied for salt fines, and the results achieved were discussed. (BBR).

5150 (INIS-XN-393) **The international hydrocoin project - Groundwater hydrology modelling strategies for performance assessment of nuclear waste disposal.** Nuclear Energy Agency, 75 - Paris (France). 1991. [336] Order Number DE93609565. Source: OSTI; NTIS (US Sales Only); INIS.

The international cooperation project HYDROCOIN for studying groundwater flow modelling in the context of radioactive waste disposal was initiated in 1984. Thirteen organisations from ten countries and two international organisations have participated in the project which has been managed by the Swedish Nuclear Power Inspectorate, SKI. This report summarises the results from the third phase of HYDROCOIN, Level 3, which has addressed the issues of uncertainty and sensitivity analysis of groundwater flow problems and how uncertainties affect the modelling results. Seven test cases were selected for the project, representing a variety of flow situations in different media, as well as variety of temporal and spatial scales. These test cases were tackled by the participating organisations (Project Teams) using a number of different codes. An overview of the methodologies used in uncertainty and sensitivity analysis is given. Results from the various Teams attempting the Test Cases are presented and conclusions are drawn as to the applicability of the results obtained to the test cases being analysed as well as the general applicability of the results. The importance of making uncertainty and sensitivity analysis as part of a performance analysis of the safety of a nuclear waste repository is stressed. The conclusion is drawn that the HYDROCOIN Level 3 study has greatly contributed to the understanding of these issues. 42 refs., 159 figs., 61 tabs.

5151 (INIS-XN-415) **The international intraval project. Phase 1 test cases.** Nuclear Energy Agency, 75 - Paris (France). 1992. [157] Order Number DE93609566. Source: OSTI; NTIS (US Sales Only); INIS.

This report contains a description of the test cases adopted in Phase 1 of the international cooperation project INTRAVAL. Seventeen test cases based on bench-scale experiments in laboratory, field tests and natural analogue studies, have been included in the study. The test cases are described in terms of experimental design and types of available data. In addition, some quantitative examples of available data are given as well as references to more extensive documentation of the experiments on which the test cases are based. Fifthteen test cases examples are given: 1 Mass transfer through clay by diffusion and advection. 2 Uranium migration in crystalline bore cores, small scale pressure infiltration experiments. 3 Radionuclide migration in single natural fractures in granite. 4 Tracer tests in a deep basalt flow top. 5 Flow and tracer experiment in crystalline rock based on the Stripa 3-D experiment. 6 Tracer experiment in a fracture zone at the Finnsjon research area. 7 Synthetic data base, based on single fracture migration experiments in Grimsel rock laboratory. 8 Natural analogue studies at Pocos de Caldas, Minais Gerais, Brazil. Redox-front and radionuclide movement in an open pit uranium mine. 9 Natural analogue studies at the Koongarra site in the Alligator Rivers area of the Northern Territory, Australia. 10 Large block migration experiments in a block of crystalline rock. 11 Unsaturated flow and transport experiments performed at Las Cruces, New Mexico. 12 Flow and transport experiment in unsaturated fractured rock performed at the Apache Leap Tuff site, Arizona. 13 Experiments in partially saturated tuffaceous rocks performed in the G-tunnel underground facility at the Nevada Test site, USA. 14 Experimental study of brine transport in porous media. 15 Groundwater flow in the vicinity of the Gorleben Salt Dome, Federal Republic of Germany.

5152 (INIS-XN-416) **The international intraval project. Phase 1 case 1b. Uranium migration in crystalline rock; borecore pressure infiltration experiments.** Hadermann, J. (ed.). Nuclear Energy Agency, 75 - Paris (France). 1992. [124] Order Number DE93609567. Source: OSTI; NTIS (US Sales Only); INIS.

The INTRAVAL study addresses validation of geosphere transport models for use in repository performance assessment. The study is structured around various test cases relevant to radioactive waste disposal. This report deals with the results from INTRAVAL test case 1b. This is based on laboratory infiltration experiments in which distilled water and a sorbing tracer (Uranium) are forcibly injected into bore cores from deep drillings. Seven project teams have investigated this test case. In the first part of this report the findings of the project teams are summarized, and in a second part their individual reports are given. The work on case 1b helped to develop and test formal frameworks of validation methodologies. Model validation aspects covered geometry of water flow paths, dispersion, channelling, tracer-rock interaction and matrix diffusion. Due to the incompleteness of the experimental data, validation of models in the classical sense was not possible. However, different models were compared and fitted parameters assessed by comparison with independent data as far as possible. Dual porosity models generally yielded good fits to uranium breakthrough curves and also to the uranium distribution in the bore core. Although the test case has provided further considerable support for the concept of matrix diffusion and has shown that a connected pore space exists over distances of centimeters in the rock matrices investigated, it is still necessary to determine how the processes scale up to lengths and time scales of interest in repository performance. 13 refs., 12 figs., 7 tabs., 7 appendices.

5153 (INIS-XN-417) **The international intraval project. Phase 1 case 2. Radionuclide migration in single natural fractures in granite.** Skagius, K. (ed.). Nuclear Energy Agency, 75 - Paris (France). 1992. [38] Order Number DE93609568. Source: OSTI; NTIS (US Sales Only); INIS.

The INTRAVAL study addresses validation of geosphere transport models for use in repository performance assessment by examining various test cases relevant to radioactive waste disposal. This report describes the results from INTRAVAL test case 2 which is based on a set of laboratory experiments studying migration of non-sorbing as well as sorbing tracers in a single fracture in granitic cores. Three project teams have investigated this test case. Models including advection, dispersion, sorption to the fracture surface, matrix diffusion and sorption within the rock matrix were calibrated against the experimental breakthrough curves. Obtained best-fit values of the parameters determining the interaction between tracer and rock were in fair agreement with independently measured data. Models neglecting matrix diffusion and sorption within the rock matrix gave poor fits to the experimental data. These results suggest the need to include matrix diffusion and matrix sorption in the model to represent data for this test case. Furthermore, it was not possible to distinguish between hydrodynamic dispersion and channelling dispersion since equally good fits were obtained with both models. Equally good fits were also obtained with models assuming constant fracture aperture and variable fracture aperture. In the context of performance assessment of repositories in fractured rock, the major outcome from this test case is additional support for the inclusion of matrix diffusion and matrix sorption in the transport models. 17 refs., 14 figs., 3 tabs.

5154 (INIS-XN-420) **The international hydrocoin project. Groundwater hydrology modelling strategies for performance assessment of nuclear waste disposal. Summary report.** Nuclear Energy Agency, 75 - Paris (France). 1992. [182] Order Number DE93609570. Source: OSTI; NTIS (US Sales Only); INIS.

In 1984 the Swedish Nuclear Power Inspectorate, SKI, initiated the international cooperation project HYDROCOIN for the study of groundwater flow modelling in the context of radioactive waste disposal. The objective of HYDROCOIN was to improve knowledge of the influence of various strategies for groundwater flow modelling for the safety assessment of final repositories for radioactive wastes. The study comprised: the impact on the groundwater flow calculations of different solution algorithms, the capabilities of different models to describe field tests and bench-scale experiments, and the impact on the groundwater flow calculations of incorporating various physical phenomena. The work was conducted at three levels addressing code verification (Level 1), model validation (Level 2), and sensitivity and uncertainty analysis of groundwater flow calculations (Level 3). This report gives an overview and summary of test cases of HYDROCOIN Level 1, the issue of validation groundwater flow models (HYDROCOIN Level 2), the methodologies used in uncertainty and sensitivity analysis (HYDROCOIN Level 3). 108 figs., 24 tabs., 2 appendices.

5155 (JAERI-M–92-091) **Investigation of waste form materials suitable for immobilizing actinide elements in high-level waste.** Hayakawa, Issei (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Kamizono, Hiroshi. Japan Atomic Energy Research Inst., Tokyo (Japan). Jul 1992. 27p. (In Japanese). Order Number DE93753266. Source: OSTI; NTIS; INIS.

The microstructure of waste form materials suitable for immobilizing actinide elements can be classified into the following two categories. (1) Actinide elements are immobilized in an crystallized matrix after the formation of solid solution or compounds. (2) Actinide elements are immobilized in a durable material by encapsulation. Based on crystal chemistry, durability data, phase diagrams, compositions of natural minerals, eleven oxide compounds and one non-oxide compound are pointed out to be new candidates included in category (1). The other survey on material compositions, manufacturing conditions and feasibility shows that SiC, glassy carbon, ZrO_2, Ti-O-Si-C ceramics are preferable matrix materials included in category (2). Polymers and fine powders are suitable as starting materials for the encapsulation of actinide elements because of their excellent sinterability. (author) 50 refs.

5156 (KFK–4800f) **Conditioning of radioactive waste solutions by cementation.** Vejmelka, P.; Rudolph, G.; Kluger, W.; Koester, R. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Nukleare Entsorgungstechnik. Feb 1992. 103p. Translated from the German report KFK–4800: Die Konditionierung radioaktiver Abfalloesungen durch Zementierung. (In French). Order Number DE93744380. Source: OSTI; NTIS (US Sales Only); INIS.

For the cementation of the low and intermediate level evaporator concentrates resulting from the reprocessing of spent fuel numerous experiments were performed to optimize the waste form composition and to characterize the final waste form. Concerning the cementation process, properties of the waste/cement suspension were investigated. These investigations include the dependence of viscosity, bleeding, setting time and hydration heat from the waste cement slurry composition. For the characterization of the waste forms, the mechanical, thermal and chemical stability were determined. For special cases detailed investigations were performed to determine the activity release from waste packages under defined mechanical and thermal stresses. The investigations of the interaction of the waste forms with aqueous solutions include the determination of the Cs/Sr release, the corrosion resistance and the release of actinides. The Cs/Sr release was determined in dependence of the cement type, additives, setting time and sample size. (orig./DG).

5157 (KTM/E-B–121) **JYT - Publicly financed nuclear waste management research programme: Annual report 1991.** Vuori, S. (ed.). Ministry of Trade and Industry, Helsinki (Finland). Energy Dept. Jul 1992. [104] Order Number DE93609571. Source: OSTI; NTIS; INIS.

The nuclear waste management research in Finland is funded both by the state and the utilities (represented in cooperation by the Nuclear Waste Commission of the Finnish power companies). A coordinated research programme (JYT) comprising the publicly financed waste management studies was started in 1989 and continues until 1993. The utilities continue to carry out a parallel research programme according to their main financial and operational responsibility for nuclear waste management. The research programme covers the following main topic areas: (1) Bedrock characteristics, groundwater and repository, (2) Release and transport of radionuclides, (3) Performance and safety assessment of repositories, and (4) Waste management technology and costs.

5158 (LA-SUB–92-10-Pt.1) **Remediation of the Maxey Flats Site: Final report.** Los Alamos National Lab., NM (United States); Science Applications International Corp., Albuquerque, NM (United States). 12 Jan 1990. 145p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93001290. Source: OSTI; NTIS; INIS; GPO Dep.

This report describes issues associated with remedial action of Maxey Flats, a low-level radioactive waste disposal site from 1963-1977, located in Fleming County, Kentucky. Present remedial action alternatives being considered are discussed along with emergency plans, ground water monitoring plans, and budgets.

5159 (LA-UR–92-3761) **Nuclear data needs for studies of accelerator induced neutron transmutation of nuclear waste.** Wilson, W.B.; England, T.R. Los Alamos National Lab., NM (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9205198–4: Organization for economic cooperation and development, Nuclear Energy Agency Nuclear Science Committee (NEANSC) specialists' meeting on fission product nuclear data, Tokai-mura (Japan), 25-27 May 1992). Order Number DE93003829. Source: OSTI; NTIS; INIS; GPO Dep.

Recent activities in accelerator-driven neutron transmutation problems have required the further development of both codes and data. In our treatment of transmutation in these medium-energy accelerator problems, the reactions of the incident beam and secondary particles are modeled with the LAHET Monte-Carlo program using online nuclear cross-section models. The position, direction and energy of neutrons born or slowing below 20 MeV are recorded for subsequent MCNP Monte-Carlo calculations with evaluated cross-section libraries. Transmutation calculations with CINDER'90 use high-energy fission and spallation product-nuclide formation rates and target-nuclide destruction rates from LAHET and the MCNP flux below 20 MeV to obtain temporal inventories of nuclides in the accelerator or target materials. These problems are characterized by the production and decay of spallation products scattered over the familiar chart of the nuclides below the compound system, plus the more familiar neutron activation of common metals and alloys. The former heavily taxes the breadth of available decay data, while the later demands precision in cross-section data common to many less-demanding neutron activation problems.

5160 (LBL-PUB–5352) **Waste management Quality Assurance Implementing Management Plan (QAIMP): Revision 1.** Lawrence Berkeley Lab., CA (United States). 1 Jun 1992. 48p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE93002592. Source: OSTI; NTIS; GPO Dep.

This report contains a summary of the groundwater and surface-water quality monitoring activities to be performed during the 1993 calendar year at the Department of Energy Y- 12 Plant in Oak Ridge, Tennessee (Figure 1). Monitoring activities will be performed in three hydrogeologic regimes: (1) the Bear Creek Hydrogeologic Regime (BCHR), (2) the Upper East Fork Poplar Creek Hydrogeologic Regime (UEFPCHR), and (3) the Chestnut Ridge Hydrogeologic Regime (CRHR). The BCHR and UEFPCHR are located within Bear Creek Valley (BCV) and the CRHR is located south of the Y-12 Plant on Chestnut Ridge (Figure 2).

5161 (LBL-PUB–5353) **Certification Plan, low-level waste Hazardous Waste Handling Facility.** Albert, R. Lawrence Berkeley Lab., CA (United States). 30 Jun 1992. 78p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE93002583. Source: OSTI; NTIS; INIS; GPO Dep.

The purpose of this plan is to describe the organization and methodology for the certification of low-level radioactive waste

(LLW) handled in the Hazardous Waste Handling Facility (HWHF) at Lawrence Berkeley Laboratory (LBL). This plan also incorporates the applicable elements of waste reduction, which include both up-front minimization and end-product treatment to reduce the volume and toxicity of the waste; segregation of the waste as it applies to certification; an executive summary of the Waste Management Quality Assurance Implementing Management Plan (QAIMP) for the HWHF and a list of the current and planned implementing procedures used in waste certification. This plan provides guidance from the HWHF to waste generators, waste handlers, and the Waste Certification Specialist to enable them to conduct their activities and carry out their responsibilities in a manner that complies with the requirements of WHC-WAC. Waste generators have the primary responsibility for the proper characterization of LLW. The Waste Certification Specialist verifies and certifies that LBL LLW is characterized, handled, and shipped in accordance with the requirements of WHC-WAC. Certification is the governing process in which LBL personnel conduct their waste generating and waste handling activities in such a manner that the Waste Certification Specialist can verify that the requirements of WHC-WAC are met.

5162 (LBL-PUB–5354) **Certification Plan, Radioactive Mixed Waste Hazardous Waste Handling Facility.** Albert, R. Lawrence Berkeley Lab., CA (United States). 30 Jun 1992. 84p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE93002584. Source: OSTI; NTIS; INIS; GPO Dep.

The purpose of this plan is to describe the organization and methodology for the certification of radioactive mixed waste (RMW) handled in the Hazardous Waste Handling Facility at Lawrence Berkeley Laboratory (LBL). RMW is low-level radioactive waste (LLW) or transuranic (TRU) waste that is co-contaminated with dangerous waste as defined in the Westinghouse Hanford Company (WHC) Solid Waste Acceptance Criteria (WAC) and the Washington State Dangerous Waste Regulations, 173-303-040 (18). This waste is to be transferred to the Hanford Site Central Waste Complex and Burial Grounds in Hanford, Washington. This plan incorporates the applicable elements of waste reduction, which include both up-front minimization and end-product treatment to reduce the volume and toxicity of the waste; segregation of the waste as it applies to certification; an executive summary of the Waste Management Quality Assurance Implementing Management Plan (QAIMP) for the HWHF (Section 4); and a list of the current and planned implementing procedures used in waste certification.

5163 (LBL-PUB–5356) **Hazardous Waste Certification Plan: Hazardous Waste Handling Facility, Lawrence Berkeley Laboratory.** Lawrence Berkeley Lab., CA (United States); Engineering-Science, Inc., Alameda, CA (United States). Feb 1992. 87p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE93002590. Source: OSTI; NTIS; INIS; GPO Dep.

The purpose of this plan is to describe the organization and methodology for the certification of hazardous waste (HW) handled in the Lawrence Berkeley Laboratory (LBL) Hazardous Waste Handling Facility (HWHF). The plan also incorporates the applicable elements of waste reduction, which include both up-front minimization and end- product treatment to reduce the volume and toxicity of the waste; segregation of the waste as it applies to certification; and executive summary of the Quality Assurance Program Plan (QAPP) for the HWHF and a list of the current and planned implementing procedures used in waste certification. The plan provides guidance from the HWHF to waste generators, waste handlers, and the Systems Group Manager to enable them to conduct their activities and carry out their responsibilities in a manner that complies with several requirements of the Federal Resource Conservation and Resource Recovery Act (RCRA), the Federal Department of Transportation (DOT), and the State of California, Code of Regulations (CCR), Title 22.

5164 (NSS/R–279) **An overview of experimental techniques developed during hydrogeological investigations at Reskajeage Quarry, Cornwall.** Bolt, J.E. (Elcon (Western) Ltd., Redruth (United Kingdom)); Pascoe, D.M.; Watkins, V.M.B. United Kingdom Nirex Ltd., Harwell (United Kingdom). Sep 1991. [34] Order Number DE93609572. Source: OSTI; NTIS (US Sales Only); INIS.

In fractured rocks, the transport of dissolved radionuclides which may be released from the near-field of a radioactive waste repository will take place dominantly through the three-dimensional network of fractures. Assessments of groundwater flow and radionuclide transport from an underground repository use continuum models, such as NAMMU, to predict radionuclide transport. To complement this approach, water flow and transport in fractured rock is being investigated at a more detailed level, using fracture network modelling. A test side, at Reskajeage Quarry in Cornwall, is currently being used to provide experimental data on flow and transport in fractured rock, to improve confidence in this modelling approach. This report describes the range of experimental techniques that have been used to obtain data on the positions, orientations and hydraulic properties of individual fractures in the slate. Also, brief descriptions of the design of a series of transport tests are given. The results of this work are described in a series of Nirex Safety Series Reports. (author).

5165 (NUREG/CR–4918-Vol.6) **Control of water infiltration into near surface LLW disposal units: Volume 6, Progress report on field experiments at a humid region site, Beltsville, Maryland.** Schulz, R.K. (California Univ., Los Angeles, CA (United States). Lab. of Biomedical and Environmental Sciences); Ridky, R.W.; O'Donnell, E. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Regulatory Applications; California Univ., Los Angeles, CA (United States). Lab. of Biomedical and Environmental Sciences; Maryland Univ., College Park, MD (United States). Dept. of Geology. Oct 1992. 24p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC08-89NV10755. Source: OSTI; NTIS; INIS; GPO.

The project objective is to assess means for controlling waste infiltration through waste disposal unit covers in humid regions. Experimental work is being performed in large scale lysimeters (70inch × 45inch × IOinch) at Beltsville, MD and results of the assessment are applicable to disposal of LLW, uranium mill tailings, hazardous waste, and sanitary landfills. Three concepts are under investigation: (1) resistive layer barrier, (2) conductive layer barrier, and bioengineering water management. The resistive layer barrier consists of compacted earth (clay). The conductive layer barrier is a special case of the capillary barrier and it requires a flow layer (e.g. fine sandy loam) over a capillary break. As long as unsaturated conditions am maintained water is conducted by the flow layer to below the waste. This barrier is most efficient at low flow rates and is thus best placed below a resistive layer barrier. Such a combination of the resistive layer over the conductive layer barrier promises to be highly effective provided there is no appreciable subsidence. Bioengineering water management is a surface cover that is designed to accommodate subsidence. It consists of impermeable panels which enhance run-off and limit infiltration. Vegetation is planted in narrow openings between panels to transpire water from below the panels. TWs system has successfully dewatered two lysimeters thus demonstrating that this procedure could be used for remedial action ("drying out") existing waterlogged disposal sites at low cost.

5166 (ORNL/ER–135) **Surface debris inventory at White Wing Scrap Yard, Oak Ridge Reservation, Oak Ridge, Tennessee: Environmental Restoration Program.** Rodriguez, R.E.; Tiner, P.F.; Williams, J.K. Oak Ridge National Lab., TN (United States). Aug 1992. 72p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93001787. Source: OSTI; NTIS; GPO Dep.

An inventory of surface debris in designated grid blocks at the White Wing Scrap Yard [Waste Area Grouping 11 (WAG 11)] was conducted intermittently from February through June 1992 by members of the Measurement Applications and Development Group, Health and Safety Research Division, Oak Ridge National Laboratory (ORNL) at the request of ORNL Environmental Restoration (ER) Program personnel. The objectives of this project are outlined in the following four phases: (1) estimate the amount (volume) and type (e.g., glass, metal and plastics) of surface waste material in 30 designated grid blocks (100- by 100-ft grids); (2)

conduct limited air sampling for organic chemical pollutants at selected locations (e.g., near drums, in holes, or other potentially contaminated areas); (3) conduct a walkover gamma radiation scan extending outward (approximately 50 ft) beyond the proposed location of the WAG 11 perimeter fence; and (4) recommend one grid block as a waste staging area. This recommendation is based on location and accessibility for debris staging/transport activities and on low levels of gamma radiation in the grid block.

5167 (ORNL/M–2377) **HFIR spent fuel management alternatives.** Begovich, J.M.; Green, V.M.; Shappert, L.B.; Lotts, A.L. Oak Ridge National Lab., TN (United States). 15 Oct 1992. 103p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93003111. Source: OSTI; NTIS; INIS; GPO Dep.

The High Flux Isotope Reactor (HFIR) at Martin Marietta Energy Systems' Oak Ridge National Laboratory (ORNL) has been unable to ship its spent fuel to Savannah River Site (SRS) for reprocessing since 1985. The HFIR storage pools are expected to fill up in the February 1994 to February 1995 time frame. If a management alternative to existing HFIR pool storage is not identified and implemented before the HFIR pools are full, the HFIR will be forced to shut down. This study investigated several alternatives for managing the HFIR spent fuel, attempting to identify options that could be implemented before the HFIR pools are full. The options investigated were: installing a dedicated dry cask storage facility at ORNL, increasing HFIR pool storage capacity by clearing the HFIR pools of debris and either close-packing or stacking the spent fuel elements, storing the spent fuel at another ORNL pool, storing the spent fuel in one or more hot cells at ORNL, and shipping the spent fuel offsite for reprocessing or storage elsewhere.

5168 (ORNL/TM–12239) **ALPHN: A computer program for calculating (α, n) neutron production in canisters of high-level waste.** Salmon, R.; Hermann, O.W. Oak Ridge National Lab., TN (United States). Oct 1992. 69p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93003641. Source: OSTI; NTIS; INIS; GPO Dep.

The rate of neutron production from (α, n) reactions in canisters of immobilized high-level waste containing borosilicate glass or glass-ceramic compositions is significant and must be considered when estimating neutron shielding requirements. The personal computer program ALPHA calculates the (α, n) neutron production rate of a canister of vitrified high-level waste. The user supplies the chemical composition of the glass or glass-ceramic and the curies of the alpha-emitting actinides present. The output of the program gives the (α, n) neutron production of each actinide in neutrons per second and the total for the canister. The (α, n) neutron production rates are source terms only; that is, they are production rates within the glass and do not take into account the shielding effect of the glass. For a given glass composition, the user can calculate up to eight cases simultaneously; these cases are based on the same glass composition but contain different quantities of actinides per canister. In a typical application, these cases might represent the same canister of vitrified high-level waste at eight different decay times. Run time for a typical problem containing 20 chemical species, 24 actinides, and 8 decay times was 35 s on an IBM AT personal computer. Results of an example based on an expected canister composition at the Defense Waste Processing Facility are shown.

5169 (PNC-TN–8410-91-274) **Volatilization behavior of semivolatile elements in vitrification of high-level liquid waste: Research report on solidification of high-level liquid waste.** Igarashi, Hiroshi (Power Reactor and Nuclear Fuel Development Corp., Tokai, Ibaraki (Japan). Tokai Works); Kato, Koh; Takahashi, Takeshi. Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan). Nov 1991. 23p. (In Japanese). Order Number DE93754142. Source: OSTI; NTIS; INIS.

The effect of temperature on the volatilization of ruthenium, technetium, and selenium was observed in calcination experiments with simulated high-level liquid waste. Technetium and selenium were more volatile as calcining temperature increased. Ruthenium was less volatile when temperature exceeded 300degC. More than 80% of ruthenium that volatilized from room temperature to 500degC occurred between 200 and 300degC. A small amount of ruthenium volatilized above 300degC as well as below 135degC. (author).

5170 (PNL–8278) **Minutes of the Tank Waste Science Panel Meeting March 25–27, 1992: Hanford Tank Safety Project.** Schutz, W.W. (comp.) (Consultant, Wellington, Delaware (United States)); Strachan, D.M. (comp.). Pacific Northwest Lab., Richland, WA (United States). Aug 1992. 382p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9203194–Summ.: Tank waste science panel meeting, Denver, CO (United States), 25-27 Mar 1992). Order Number DE93002357. Source: OSTI; NTIS; INIS; GPO Dep.

Discussions from the seventh meeting of the Tank Waste Science are presented in Colorado. The subject areas included the generation of gases in Tank 241-SY-101, the possible use of sonication as a mitigation method, and analysis for organic constituents in core samples. Results presented and discussed include: Ferrocyanides appear to be rapidly dissolved in 1M NaOH; upon standing in the laboratory at ambient conditions oxalate precipitates from simulated wastes containing HEDTA. This suggests that one of the main components in the solids in Tank 241-SY-101 is oxalate; hydrogen evolved from waste samples from Tank 241-SY-101 is five times that observed in the off gas from the tank; data suggest that mitigation of Tank 241-SY-101 will not cause a high release of dissolved N_2O; when using a slurry for radiation studies, a portion of the generated gases is very difficult to remove. To totally recover the generated gases, the solids must first be dissolved. This result may have an impact on mitigation by mixing if the gases are not released. Using ^{13}C-labeled organics in thermal degradation studies has allowed researchers to illucidate much of the kinetic mechanism for the degradation of HEDTA and glycolate. In addition to some of the intermediate, more complex organic species, oxalate, formate, and CO_2 were identified; and analytic methods for organics in radioactive complex solutions such as that found in Tank 241-SY-101 have been developed and others continue to be developed.

5171 (SAND–90-1983) **User's reference manual for CAMCON: Compliance Assessment Methodology Controller: Version 3.0.** Rechard, R.P. (ed.). Sandia National Labs., Albuquerque, NM (United States). Aug 1992. 639p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93001404. Source: OSTI; NTIS; INIS; GPO Dep.

The performance Assessment (PA) Department of Sandia National Laboratories annually compares the Waste Isolation Pilot Plant (WIPP) with the Environmental Protection Agency's Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes, 40 CFR 191. To assist the analyst in these comparisons the PA Department developed CAMCON, the Compliance Assessment Methodology Controller, which creates an analysis system out of the diverse computer modeling codes needed for this interdisciplinary comparison. This reference manual describes the use of most of the codes in the CAMCON system that an analyst may use when performing the PA comparisons. Although some of the codes included in CAMCON have their own user's guide, this manual summarizes these guides as well to provide the user with one comprehensive document of the codes within the CAMCON system.

5172 (UCRL–53943-91, pp. 134-136) **Stochastic models for predicting pitting corrosion damage of radioactive-waste containers.** Henshall, G.A. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

The authors explored stochastic models of pitting corrosion and found them to be potentially useful in predicting damage of radioactive-waste containers. These models can simulate pit initiation and growth under various environments, including those that change during exposure. Equally important is that they provide quantitative information useful to performance assessment models of the entire waste repository system. Valuable insights into the

mechanisms of pit initiation and growth have resulted from this research.

5173 (WHC-SD-WM-ES–219) **Laboratory flammability studies of mixtures of hydrogen, nitrous oxide, and air: Final report.** Cashdollar, K.L. (Bureau of Mines, Pittsburgh, PA (United States). Pittsburgh Research Center); Hertzberg, M.; Zlochower, I.A.; Lucci, C.E.; Green, G.M.; Thomas, R.A. Westinghouse Hanford Co., Richland, WA (United States); Bureau of Mines, Pittsburgh, PA (United States). Pittsburgh Research Center. 26 Jun 1992. 71p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI06-91RL12253 ;AC06-87RL10930. Order Number DE93005134. Source: OSTI; NTIS; INIS; GPO Dep.

At the request of the Department of Energy and the Westinghouse Hanford Company, the Bureau of Mines has investigated the flammability of mixtures of hydrogen, nitrous oxide, and air. This work is relevant to the possible hazards of flammable gas generation from nuclear waste tanks at Hanford, WA. The tests were performed in a 120-L spherical chamber under both quiescent and turbulent conditions using both electric spark and pyrotechnic ignition sources. The data reported here for binary mixtures of hydrogen in air generally confirm the data of previous investigators, but they are more comprehensive than those reported previously. The results clarify to a greater extent the complications associated with buoyancy, turbulence, and selective diffusion. The data reported here for ternary mixtures of hydrogen and nitrous oxide in air indicate that small additions of nitrous oxide (relative to the amount of air) have little effect, but that higher concentrations of nitrous oxide (relative to air) significantly increase the explosion hazard.

5174 (WHC-SP–0841) **Maintenance Implementation Plan for the Plutonium Finishing Plant.** LaRock, E.M. Westinghouse Hanford Co., Richland, WA (United States). Jun 1992. 55p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93001670. Source: OSTI; NTIS; INIS; GPO Dep.

This document outlines the Maintenance Implementation Plan (MIP) for the Plutonium Finishing Plant (PFP) located on the Hanford Site at Richland, Washington. This MIP addresses the maintenance program at PFP as it relates to US Department of Energy (DOE) DOE Order 4330.4A (DOE 1990a). In addition to contrasting the PFP Maintenance program to the DOE order, the MIP lays out the key actions to be undertaken to mare closely meet the requirements of the order in an effort to develop a more cost-effective and efficient maintenance program.The PFP operates to purify plutonium from scrap metal and nitrate solutions. The PFP Maintenance strategy is to provide the facility with systems and equipment that will be able to sustain the scheduled operation of the PRF section of the PFP. This operating run is scheduled to last two years. Activities following the stabilization operation will involve completing an environmental impact statement (EIS) to detemine future plant activities. This strategy also includes long term maintenance of the facility for safe occupancy and material storage. The major improvement activities identified in this MIP are in the areas of organization and administration, personnel training and qualification, and maintenance procedures. Other key focuses will be in the measuring and test equipment (M&TE) area, planning and scheduling, and in management involvement.

5175 (WHC-SP–0850) **Maintenance Implementation Plan for the Waste Tank maintenance and production management.** Kerwick, D.P. Westinghouse Hanford Co., Richland, WA (United States). Jun 1992. 67p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93001677. Source: OSTI; NTIS; INIS; GPO Dep.

The objective of the Maintenance Implementation Plan (MIP) is to describe how the Waste Tank facility will implement the requirements established by DOE Order 4330.4A, Maintenance Management Program, Chapter 2.0 Nuclear Facilities (DOE 1990). The plan provides a blueprint for a disciplined approach to implementation and compliance. In addition to the elements described in Chapter 2.0 of the order, the MIP also addresses how the Graded Approach to Maintenance will be used. Section 3.0 of the plan separates facility structures, systems, and components into four separate categories; safety, process, facility systems not related to safety or the process, and other parts of the facility infrastructure. It describes the level of detail that must be applied to each of the categories, the priority that must be assigned to preventive and corrective maintenance related to these categories. It also describes the process used to determine the category assigned to structures, systems and components.

5176 (WHC-SP–0851) **Maintenance Implementation Plan for solid waste.** Adrian, J.D. Westinghouse Hanford Co., Richland, WA (United States). Jun 1992. 75p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93001669. Source: OSTI; NTIS; INIS; GPO Dep.

This Maintenance Implementation Plan (MIP) has been developed for. implementation of the US Department of Energy (DOE) Order 4330.4A. Maintenance Implementation Program (DOE 1990) at the Hanford Site Solid Waste complex. It addresses maintenance functions associated with Solid Waste Management, which includes the field operational group and the facilities operational group. An assessment of the existing maintenance programs for Solid Waste was performed, and the results of this assessment were evaluated to determine corrective actions required to bring Solid Waste Maintenance into compliance with the order. The MIP assessment disclosed that most elements defined in the order are currently implemented for Solid Waste. It also identified issues which must be addressed to bring the maintenance function into full compliance with DOE Order 4330.4A. These include documentation of the maintenance training program, expanded scope of inspections to address the As Low As Reasonably Achievable (ALARA) concept, development of a Master Equipment List (MEL), and more adequate facilities to provide enhanced storage and control of tools and equipment.

5177 (WSRC-MS–91-511) **Constant extension rate testing of Type 304L stainless steel in simulated waste tank environments.** Wiersma, B.J. Westinghouse Savannah River Co., Aiken, SC (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-920458–11: Corrosion '92 conference and exhibition, Nashville, TN (United States), 27 Apr - 1 may 1992). Order Number DE93002807. Source: OSTI; NTIS; INIS; GPO Dep.

New tanks for storage of low level radioactive wastes will be constructed at the Savannah River Site (SRS) of AISI Type 304L stainless steel (304L). The presence of chlorides and fluorides in the wastes may induce Stress Corrosion Cracking (SCC) in 304L. Constant Extension Rate Tests (CERT) were performed to determine the susceptibility of 304L to SCC in simulated wastes. In five of the six tests conducted thus far 304L was not susceptible to SCC in the simulated waste environments. Conflicting results were obtained in the final test and will be resolved by further tests. For comparison purposes the CERT tests were also performed with A537 carbon steel, a material similar to that utilized for the existing nuclear waste storage tanks at SRS.

5178 (WSRC-RP–92-703) **Final wash precipitate feed simulants for DWPF Cold Chemical Runs.** Marek, J.C. Westinghouse Savannah River Co., Aiken, SC (United States). 15 May 1992. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93003706. Source: OSTI; NTIS; INIS; GPO Dep.

The Defense Waste Processing Facility (DWPF) is scheduled to start non-radioactive process operation in September, 1992. The Cold Chemical Runs will demonstrate acceptable process operation and provide data required to satisfy the Waste Compliance Plan. Five basic sludge simulants will be required for these tests. Two basic precipitate simulants will be needed to operate the Salt Processing Cell with and without mercury in the precipitate feed. Precipitate feed simulant specifications for DWPF Cold Chemical Runs are revised in this report. All previous specifications of precipitate feed simulants for DWPF Cold Chemical Runs (CCRs) are superceded by this document. The revision is needed to (1) eliminate use of hydroxylamine nitrate (HAN) in the precipitate process operation, (2) simulate the projected composition of the precipitate feed to DWPF produced by final washing to reduce the nitrite concentration to $\leq$ 0.01M without washing the simulated feed, (3) delete organic trim chemical additions to the precipitate feed and (4) specify an additive to prevent foaming of the precipitate. Two specifications are provided to operate the Salt Processing Cell with

mercury (Tests 5&6) and without mercury (Tests 1–4) in the precipitate feed.

5179 (WSRC-TR–92-006) **Organics in the chemical processing cell and their potential effects on the DWPF operations.** Hutson, N.D. Westinghouse Savannah River Co., Aiken, SC (United States). 7 Jan 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93002812. Source: OSTI; NTIS; INIS; GPO Dep.

Based on observations made during the operation of the Integrated DWPF Melter System, aromatic organics entering the DWPF Chemical Processing Cell (CPC) can be expected to distribute throughout the CPC Process Vessel Vent System and Mercury Purification Cell. The potential impacts to the operation of the DWPF are discussed.

5180 (WSRC-TR–92-284) **Uniformity of material in the SME and MFT.** Plodinec, M.J. Westinghouse Savannah River Co., Aiken, SC (United States). 29 May 1992. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93003376. Source: OSTI; NTIS; INIS; GPO Dep.

The DWPF will satisfy the product consistency specification in the Waste Acceptance Preliminary Specifications through control of the chemical composition of the glass product. This control will be achieved by ensuring that each batch of feed in the Slurry Mix Evaporator (SME) will produce glass which satisfies the specification. The purpose of this report is to determine what degree of uniformity can be expected of material in the SME and Metter Feed Tank (MFT). These vessels were designed based on a design development process which had proven successful for similar hard-to-mix feeds in the past. This process resulted in a design of the SME and MFT agitation systems which was intended to provide highly uniform melter feed material. Based on the results of extensive tests in protoypic equipment, the SME and MFT designs have met this design goal.

5181 (Y/ER–29) **DARA Solid Storage Facility evaluation and recommendations, Y-12 Bear Creek Burial Grounds, Oak Ridge, Tennessee: Environmental Restoration Program.** Barton, W.D. III; Hughey, J.C. Oak Ridge Y-12 Plant, TN (United States). Aug 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OS21400. Order Number DE92041274. Source: OSTI; NTIS; INIS; GPO Dep.

The Disposal Area Remedial Action (DARA) Solid Storage Facility (SSF) is a rectangular concrete vault with two high-density Polyethlene (HDPE) liners and covered with a metal building. The SSF was originally designed and constructed to receive saturated sediments from the excavation of the Oil Retention Ponds and Tributary 7 at the Oak Ridge Y-12 Plant. The sediments placed in the SSF were generally high-water-content soils contaminated with polychlorinated biphenyls (PCBs) and volatile organic carbons. The facility was intended to dewater the sediments by allowing the free water to percolate to a 6-in. sand layer covering the entire floor of the facility. The sand layer then drained into sumps located at the east and west ends of the facility. An application for a Part-B Permit was submitted to the state of Tennessee in February 1992 (MMES 1992a). This report is being submitted to support approval of that permit application and to address certain issues known to the regulators regarding this facility.

0530 Environmental Aspects

Refer also to citation(s) 5045, 5061, 5062, 5063, 5090, 5102, 5112, 5134, 5186, 6587, 6590, 6595, 6697

5182 (DOE/EA–0533) **Vapor space sampling of ferrocyanide tanks, Hanford Site, Richland, Washington: Environmental Assessment.** USDOE Office of Environmental Restoration and Waste Management, Washington, DC (United States). Jul 1991. 21p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93002209. Source: OSTI; NTIS; GPO Dep.

Environmental assessment (EA), to assess environmental impacts associated with tank vapor space (dome) gas sampling of 24 Hanford Site single-shell waste tanks that contain ferrocyanide-nitrate compounds to determine whether or not the tanks contain flammable or toxic gases. The proposed action would be conducted using non-sparking materials, sparkless tools, and a portable containment shelter (greenhouse) and plastic ground cover. DOE needs to take this action to help define the required controls to prevent or mitigate the potential for an accident during future, more intrusive sampling of these tanks. Based on the evaluation in the EA (which examined the environmental impacts of the proposed action and reasonable alternatives), DOE has determined that the proposed action is not a major Federal action significantly affecting the quality of the human environment, within the meaning of the National Environmental Policy Act of 1969. Therefore, the preparation of an Environmental Impact Statement is not required, and the Department is issuing this Finding of No Significant Impact (FONSI).

5183 (WHC-EP–0444) **Facility Effluent Monitoring Plan determinations for the Operations Support Services facilities (100, 200, 300, 400, and 1100 Areas): Environmental assurance.** Nickels, J.M. Westinghouse Hanford Co., Richland, WA (United States). Nov 1991. 92p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93001750. Source: OSTI; NTIS; GPO Dep.

The Facility Effluent Monitoring Plan determinations were conducted for the Westinghouse Hanford Company Operations Support Services facilities in the 100, 200, 300, 400, and 1100 Areas on the Hanford Site. The Facility Effluent Monitoring Plan determinations have been prepared in accordance with A Guide For Preparing Hanford Site Facizity Effluent Monitoring Plans (WHC 1991). Fifty-nine Operations Support Services facizities were evaluated. A Facility Effluent Monitoring Plan determination was performed on the facilities in the following list: Export Water System, 1171-A Vehicle Wash, 1172-A Service Station, 1171 Shop Facility, 1176 Tire Storage Building, 3705 Building (Photo Laboratory), 3717B Building (Standards Laboratory), 3709 Building (Paint Facility), 321 Building, 337/3718M Building, and 305 Engineering Laboratory. Hazardous materials and radioactive materials inventories were performed at the facilities. It was determined that no plan for monitoring is needed at this time.

0540 Health and Safety

Refer also to citation(s) 5070, 5071, 5072, 5073, 5074, 5076, 5077, 5078, 5081, 5082, 5083, 5084, 5085, 5086, 5089, 5096, 5112, 5127, 5130, 5131, 5158, 5175, 5181, 5182, 5515, 5523, 5532, 5533, 5534, 5554, 5584, 5585, 5586, 5621, 5628, 5693, 6556, 6586, 6596, 6674, 6685, 6686, 6696, 6697

5184 (DOE/EA–0625-Final-Pub.Com.) **Subsurface Interim Measures/Interim Remedial Action Plan and Decision Document for the 903 Pad, Mound, and East Trenches Areas (Operable Unit No. 2): Public comment, Responsiveness summary: Final.** EG and G Rocky Flats, Inc., Golden, CO (United States). Rocky Flats Plant. 10 Sep 1992. 73p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93002251. Source: OSTI; NTIS; INIS; GPO Dep.

The Department of Energy (DOE) is pursuing an Interim Measure/Interim Remedial Action (IM/IRA) at the 903 Pad, Mound, and East Trenches Areas (Operable Unit No. 2) at the Rocky Flats Plant (RFP). This MIRA is to be conducted to provide information that will aid in the selection and design of final remedial actions at OU2 that will address removal of suspected free-phase volatile organic compound (VOC) contamination. The Plan involves investigating the removal of residual free-phase VOCs by in situ vacuum-enhanced vapor extraction technology at 3 suspected VOC source areas within OU2. VOC-contaminated vapors extracted from the subsurface would be treated by granular activated carbon (GAC) adsorption and discharged. The Plan also includes water table depression, when applicable at the test sites, to investigate the performance of vapor extraction technology in the saturated zone. The Plan provides for treatment of any contaminated ground water recovered during the IM/IRA at existing RFP treatment facilities. The proposed MVIRA Plan is presented in the document entitled "Proposed Subsurface Interim Measures/Interim

Remedial Action Plan/Environmental Assessment and Decision Document, 903 Pad, Mound, and East Trenches Areas, Operable Unit No. 2, " dated 20 March 1992. Information concerning the proposed Subsurface IM/IRA was presented during a DOE Quarterly Review meeting held on 07 April 1992 and a public meeting held on 07 May 1992, at the Marriott Hotel in Golden, Colorado. The Responsiveness Summary presents DOE's response to all comments received at the public meeting, as well as those mailed to date to DOE during the public comment period.

5185 (DOE/EIS–0185D-160) **Proposed plan for remedial action at the chemical plant area of the Weldon Spring site.** USDOE Oak Ridge Field Office, TN (United States); Argonne National Lab., IL (United States). Nov 1992. 73p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-86OR21548 ;W-31109-ENG-38. (DOE/OR/21548–160). Order Number DE93003923. Source: OSTI; NTIS; INIS; GPO Dep.

This proposed plan addresses the management of contaminated material at the chemical plant area of the Weldon Spring site and nearby properties in St. Charles County, Missouri. The site consists of a chemical plant area and a noncontiguous limestone quarry, both of which are radioactively and chemically contaminated as a result of past processing and disposal activities. Explosives were produced at the chemical plant in the 1940s, and uranium and thorium materials were processed in the 1950s and 1960s. Various liquid, sludge, and solid wastes were disposed of at the Chemical plant area and in the quarry during that time. The Weldon Spring site is listed on the National Priorities List (NPL) of the US Environmental Protection Agency (EPA), and the US Department of Energy (DOE) is conducting cleanup activities at the site under its Environmental Restoration and Waste Management Program. The proposed plan is organized as follows: Chapter 2 presents the history and setting of the Weldon Spring site and briefly describes the contaminated material at the chemical plant area. Chapter 3 defines the scope of the remedial action and its role in the Weldon Spring Site Remedial Action Project. Chapter 4 summarizes the risks associated with possible exposures to site contaminants in the absence of remedial action and identifies proposed cleanup levels for soil. Chapter 5 briefly describes the final alternatives considered for the remedial action. Chapter 6 summarizes the evaluation of final alternatives for managing the contaminated material, identifies the currently preferred alternative, and discusses a possible contingency remedy to provide treatment flexibility. Chapter 7 presents the community's role in this action. Chapter 8 is a list of the references cited in this proposed plan.

5186 (DOE/ID/12584–103) **Monticello Millsite environmental report for calendar year 1991.** Chem-Nuclear Geotech, Inc., Grand Junction, CO (United States). May 1992. 112p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-86ID12584. Order Number DE93002870. Source: OSTI; NTIS; INIS; GPO Dep.

This report contains information pertaining to environmental activities conducted during calendar year 1991 at and near the inactive uranium millsite in Monticello, Utah. Environmental activities conducted at the Monticello Millsite during 1991 included those associated with remedial action and compliance monitoring. Compliance monitoring consisted of both radiological and nonradiological monitoring of air, surface water, and ground water. Radiological and nonradiological air monitoring at the millsite included measurements of atmospheric radon, particulate matter, and gamma radiation. Surface water monitoring included water quality measurements within Montezuma Creek. Ground water monitoring was conducted for two aquifers underlying the Monticello Millsite – a shallow, alluvial aquifer and a deeper, confined Burro Canyon aquifer. The shallow aquifer is contaminated by leached products of uranium mill tailings. During 1991, Uranium Mill Tailings Radiation Control Act and state of Utah ground water standards for arsenic, selenium, molybdenum. uranium 234+238, gross alpha particle activity, and radium-226+228 were exceeded in one or more wells. Samples collected from the deeper Burro Canyon aquifer revealed that no federal or state standards were exceeded.

5187 (DOE/RL–88-35) **RCRA facility investigation/corrective measures study work plan for the 100-HR-1 operable unit, Hanford Site, Richland, Washington.** USDOE Richland Field Office, WA (United States). Sep 1992. 306p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93003388. Source: OSTI; NTIS; INIS; GPO Dep.

Four areas of the Hanford Site (the 100, 200, 300, and 1100 Areas) have been included on the US. Environmental Protection Agency's (EPA's) National Priorities List (NPL) under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). Under the Hanford Federal Facility Agreement and Consent Order, signed by the Washington State Department of Ecology (Ecology), EPA, and the US Department of Energy (DOE), more than 1,000 inactive waste disposal and unplanned release sites on the Hanford Site have been grouped into a number of source and groundwater operable units. These operable units contain contamination in the form of hazardous waste, radioactive/hazardous mixed waste, and other CERCLA hazardous substances. This work plan and the attached supporting project plans establish the operable unit setting and the objectives, procedures, tasks, and schedule for conducting the RCRA facility investigation/corrective measures study (RFI/CMS) for the 100-HR-1 source operable unit. Source operable units include facilities and unplanned release sites that are potential sources of contamination. The 100-HR-3 operable unit underlies the D/DR and H Areas, the 600 Area between them, and the six source operable units these areas contain. The 100-HR-3 operable unit includes all contamination found in the aquifer soils and water within its boundary. Separate work plans have been initiated for the 100-HR-3 groundwater operable unit (DOE-RL 1992a) and the 100-DR-1 (DOE-RL 1992b) source operable units.

5188 (DOE/RL–88-36) **RCRA facility investigation/corrective measures study work plan for the 100-HR-3 operable unit, Hanford Site, Richland, Washington.** USDOE Richland Operations Office, WA (United States). Sep 1992. 336p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93003389. Source: OSTI; NTIS; INIS; GPO Dep.

Four areas of the Hanford Site (the 100, 200, 300, and 1100 Areas) have been included on the US Environmental Protection Agency's (EPA's) National Priorities List (NPL) under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). Under the Hanford Federal Facility Agreement and Consent Order, signed by the Washington State Department of Ecology (Ecology), EPA, and the US Department of Energy (DOE), more than 1000 inactive waste disposal and unplanned release sites on the Hanford Site have been grouped into a number of source and groundwater operable units. These operable units contain contamination in the form of hazardous waste, radioactive/hazardous mixed waste, and other CERCLA hazardous substances. Also included in the Tri-Party Agreement are 55 Resource Conservation and Recovery Act (RCRA) treatment, storage, or disposal (TSD) facilities that will be closed or permitted to operate in accordance with RCRA regulations, under the authority of Chapter 173-303 Washington Administrative Code (WAC). Some of the TSD facilities are included in the operable units. This work plan and the attached supporting project plans establish the operable unit setting and the objectives, procedures, tasks, and schedule for conducting the RCRA facility investigation/corrective measures study (RFI/CMS) for the 100-HR-3 operable unit. The 100-HR-3 operable unit underlies the D/DR and H Areas, the 600 Area between them, and the six source operable units these areas contain. The 100-HR-3 operable unit includes all contamination found in the aquifer soils and water within its boundary. Source operable units include facilities and unplanned release sites that are potential sources of contamination. Separate work plans have been initiated for the 100-DR-1 (DOE-RL 1992a) and 100-HR-1 (DOE-RL 1992b) source operable units.

5189 (DOE/S–00097P-Vol.1) **Environmental restoration and waste management five-year plan, Fiscal years 1994–1998: Volume 1.** USDOE, Washington, DC (United States). Jan 1993. 344p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93005892. Source: OSTI; NTIS; INIS; GPO; GPO Dep.

In March 1989, Secretary of Energy James D. Watkins outlined his vision for a changed Department of Energy (DOE) culture. This culture is one of environmental responsibility, increased knowledge and involvement in environmental management, a new openness to public input, and overall accountability to the Nation for its actions. Over the past three years, the Five Year Plan has evolved into the primary planning tool for the DOE Environmental Restoration and Waste Management Program, looking beyond the current three-year Federal budget horizon. The FY 1994–1998 Five-Year Plan demonstrates DOE's commitment to a culture based on the principles of openness, responsiveness, and accountability; reports on the progress made in carrying out DOE's environmental mission; identifies what must be accomplished during a five-year planning period; and describes strategies for achieving critical program objectives. The Five-Year Plan is not exclusively focused on near-term activities. It also expresses the DOE commitment to a 30-year goal for the cleanup of the 1989 inventory of inactive sites. This goal was established in response to recommendations from the State and Tribal Government Working Group (STGWG) that DOE define a specific end point for completing necessary remediation and restoration activities. The FY 1994–1998 Five-Year Plan reiterates the DOE commitment to meeting this and other important environmental goals.

5190 (DOE/S–00097P-Vol.2) **Environmental restoration and waste management five-year plan, Fiscal years 1994–1998: Installation summaries.** USDOE, Washington, DC (United States). Jan 1993. 248p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93004731. Source: OSTI; NTIS; INIS; GPO; GPO Dep.

The US Department of Energy (DOE) understands that cleaning up the Nation's nuclear-related sites and facilities affects many different segments of the public, ranging from communities near DOE facilities to engineers concerned with developing new technologies to clean up the environment. In an effort to make the Environmental Restoration and Waste Management Five-Year Plan for Fiscal Years (FY) 1994–1998 more responsive to your concerns, DOE invites your comments on the plan. Volume II contains 37 Installation Summaries that provide a synopsis of past, present and future activities of each major installation, and Progress Charts.

5191 (ES/ER/TM–40) **Background risk information to assist in risk management decision making: Environmental Restoration Program.** Hammonds, J.S.; Hoffman, F.O.; White, R.K.; Miller, D.B. Oak Ridge National Lab., TN (United States). Oct 1992. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93001422. Source: OSTI; NTIS; INIS; GPO Dep.

The evaluation of the need for remedial activities at hazardous waste sites requires quantification of risks of adverse health effects to humans and the ecosystem resulting from the presence of chemical and radioactive substances at these sites. The health risks from exposure to these substances are in addition to risks encountered because of the virtually unavoidable exposure to naturally occurring chemicals and radioactive materials that are present in air, water, soil, building materials, and food products. To provide a frame of reference for interpreting risks quantified for hazardous waste sites, it is useful to identify the relative magnitude of risks of both a voluntary and involuntary nature that are ubiquitous throughout east Tennessee. In addition to discussing risks from the ubiquitous presence of background carcinogens in the east Tennessee environment, this report also presents risks resulting from common, everyday activities. Such information should, not be used to discount or trivialize risks from hazardous waste contamination, but rather, to create a sensitivity to general risk issues, thus providing a context for better interpretation of risk information.

5192 (HW–18385) **A review of past experiences with H.I. survey problems.** Thorburn, R.C. Hanford Works, Richland, WA (United States). 26 Jun 1950. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93000322. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report describes contamination in the 100, 200, and 300 areas at Hanford in 1956.

5193 (ORNL/ER–85) **Functional requirements of the borrow area and haul route for the Waste Area Grouping projects at Oak Ridge National Laboratory, Oak Ridge, Tennessee.** Miller, D.G. Oak Ridge National Lab., TN (United States). Sep 1992. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93000977. Source: OSTI; NTIS; INIS; GPO Dep.

This report describes the mission and functional requirements for the development of a borrow area and the associated haul route to support closure and/or remediation of Waste Area Grouping (WAG) 6 and other WAGs at Oak Ridge National Laboratory. This document specifies the basic functional requirements that must be met by the borrow area and haul route developed to produce low-permeability soil for the covers or caps at WAG 6.

5194 (ORNL/ER–141) **Annual summary report of the Decontamination and Decommissioning surveillance and maintenance program at Oak Ridge National Laboratory for period ending September 30, 1992: Environmental Restoration Program.** Ford, M.K.; Holder, L. Jr. Oak Ridge National Lab., TN (United States). Environmental Restoration Div. Sep 1992. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93001423. Source: OSTI; NTIS; INIS; GPO Dep.

The Oak Ridge National Laboratory (ORNL) Decontamination and Decommissioning (D&D) Program is part of the Department of Energy (DOE) Environmental Restoration D&D Program and has continued to provide surveillance and maintenance (S&M) support for 34 surplus facilities. The objectives are (1) to ensure adequate containment of residual radioactive materials remaining in the facilities, (2) to provide safety and security controls to minimize the potential hazards to on-site personnel and to the general public, and (3) to manage the facilities in the most cost-effective manner while awaiting decommissioning. This support has included work in three principal areas: (1) S&M planning, (2) routine S&M, and (3) special projects designed to correct serious facility deficiencies beyond the scope of routine maintenance.

5195 (ORNL/TM–12232) **Evaluation of criticality alarm response at the WEMCO Fernald site.** Broadhead, B.L.; Childs, R.L.; Westfall, R.M.; Parks, C.V. Oak Ridge National Lab., TN (United States). Nov 1992. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93003585. Source: OSTI; NTIS; GPO Dep.

This work quantifies the expected dose rates at a series of criticality alarm locations due to several postulated criticality accidents at the Westinghouse Environmental MANAGEMENT COMPANY OF OHIO (WEMCO) Fernald site. One- and two-dimensional discrete- ordinates calculations were performed for seven different shielding configurations using leakage spectra corresponding to two specific postulated critical events. In addition, an estimate of the gaseous fission products released during the hypothetical accident was made using ORIGEN-S point-depletion code.

5196 (PNL–8333) **Preliminary evaluation of selected in situ remediation technologies for Volatile Organic Compound contamination at Arid sites.** Lenhard, R.J.; Gerber, M.A.; Amonette, J.E. Pacific Northwest Lab., Richland, WA (United States). Oct 1992. 65p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002182. Source: OSTI; NTIS; GPO Dep.

To support the Volatile Organic Compounds-Arid Site (VOC-Arid) Integrated Demonstration (ID) in its technical, logistical, institutional, and economical testing of emerging environmental management and restoration technologies. Pacific Northwest Laboratory(a) is evaluating several in situ remediation technologies for possible inclusion in the demonstration. The evaluations are made with respect to the initial focus of the VOC-Arid ID: the carbon tetrachloride contamination at the Hanford Site, where it was disposed to the vadose zone along with other volatile and nonvolatile organic wastes. heavy metals, acids. and radionuclides. The purposes of this report are (1) to identify candidate in situ technologies for inclusion in the program, (2) to evaluate the candidate technologies based on their potential applicability to VOC contamination at arid sites and geologic conditions representative of the ID

host site (i.e., Hanford Site), and (3) to prioritize those technologies for future US Department of Energy (DOE) support.

5197 (PNL–8413) **Evaluation of construction safety in DOE course taught in Aiken, South Carolina August 4–August 7, 1992.** Handwerk, E.C. Pacific Northwest Lab., Richland, WA (United States). Dec 1992. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93005603. Source: OSTI; NTIS; GPO Dep.

This report summarizes trainee evaluations for the Safety and Health Training Section course, "Construction Safety in DOE" which was conducted August 4–7 at Westinghouse Savannah River, in Aiken, South Carolina. Section 1.1 and 1.2 of this report summarize the quantitative course evaluations that trainees provided upon completion of the course. Appendix A provides a transcript of the trainees' written comments.

5198 (PNL–8419) **Evaluation of injury/illness recordkeeping pilot course taught in Richland, Washington, June 18, 1992.** Wright, T.S. Pacific Northwest Lab., Richland, WA (United States). Nov 1992. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93004482. Source: OSTI; NTIS; GPO Dep.

This report summarizes trainee evaluations for the Safety Training Section course, Injury/Illness Recordkeeping which was conducted June 18, at Hanford, in richland, Washington. This class was the second pilot course taught. This class was designed to aquaint attendees with DOE orders 5484.1, 5484.1A, draft 3 and OSHA regulations found in 29 CFR 1904.

5199 (PNL-SA–20868) **Office of Technology Development integrated program for development of in situ remediation technologies.** Peterson, M. Pacific Northwest Lab., Richland, WA (United States). Aug 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-920851–81: Spectrum '92: nuclear and hazardous waste management international topical meeting, Boise, ID (United States), 23-27 Aug 1992). Order Number DE93001312. Source: OSTI; NTIS; INIS; GPO Dep.

The Department of Energy's Office of Technology Development has instituted an integrated program focused on development of in situ remediation technologies. The development of in situ remediation technologies will focus on five problem groups: buried waste, contaminated soils, contaminated groundwater, containerized wastes and underground detonation sites. The contaminants that will be included in the development program are volatile and non volatile organics, radionuclides, inorganics and highly explosive materials as well as mixtures of these contaminants. The In Situ Remediation Integrated Program (ISR IP) has defined the fiscal year 1993 research and development technology areas for focusing activities, and they are described in this paper. These R&D topical areas include: nonbiological in situ treatment, in situ bioremediation, electrokinetics, and in situ containment.

5200 (POEF/ER–4548) **Annual summary report surveillance and maintenance program, FY 1992 activities: Environmental Restoration Decontamination and Decommissioning Program.** Schloesslin, W. Portsmouth Gaseous Diffusion Plant, OH (United States). Nov 1992. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-76OR00001. Order Number DE93003320. Source: OSTI; NTIS; GPO Dep.

The D&D Program at the Portsmouth Gaseous Diffusion Plant (PORTS) is part of the Environmental Restoration and Waste Management Program (ERWM). This work is funded through the Office of Environmental Restoration and Waste Management (EW-20). Its objective is to provide PORTS the capability to meet applicable environmental regulations through facility decommissioning activities and site decontamination actions. In support of this objective, the D&D Program provides collective management of sites within PORTS which are in need of D&D action, prioritizes those areas in terms of health, safety, and environmental concerns; and implements the appropriate level of remedial action. The program provides support to facilities which formerly served one or more of the many PORTS functions. Program activities include surveillance and maintenance of facilities awaiting decommissioning; planning safe and orderly facility decommissioning; and implementing a program to accomplish facility dispositioning in a safe, cost effective, and timely manner. The S&M Program is part of the D&D Program and was established at PORTS in FY 1989 to accomplish the following objectives: Ensure adequate containment of residual radioactive and hazardous materials remaining in inactive facilities; Provide safety and security controls to minimize the potential hazards to on-site personnel and the general public; and, manage the facilities awaiting decommissioning in the most cost effective manner.

5201 (RFP–4645) **Duct Remediation Program: Engineered access research and construction.** Beckman, T.D.; Davis, M.M.; Karas, T.M. EG and G Rocky Flats, Inc., Golden, CO (United States). [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC34-90DP62349. (CONF-9210194–3: International symposium on environmental contamination, Budapest (Hungary), 12-16 Oct 1992). Order Number DE93002261. Source: OSTI; NTIS; INIS; GPO Dep.

The Rocky Flats Plant, Duct Remediation mission concentrated on removing Plutonium Oxide from the process ductwork in the primary Plutonium processing facility. When possible, remediation took place from existing process gloveboxes. Fifteen locations were identified, however, that required accessing duct runs where no process gloveboxes existed. The building's second floor utility areas had many locations where long, inaccessible duct runs were prevalent. Consequently, an extensive program for design, procurement and construction was initiated to contain and isolate ducts for penetration when existing glovebox sites were not present.

5202 (SAND–92-0817C) **Electrokinetic remediation of unsaturated soils.** Lindgren, E.R. (Sandia National Labs., Albuquerque, NM (United States)); Kozak, M.W.; Mattson, E.D. Sandia National Labs., Albuquerque, NM (United States). [1992]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9209229–2: Industrial and engineering chemistry (I&EC) special symposium of the American Chemical Society (ACS), Atlanta, GA (United States), 21-23 Sep 1992). Order Number DE93000741. Source: OSTI; NTIS; INIS; GPO Dep.

Heavy-metal contamination of soil and groundwater is a widespread problem in the DOE weapons complex, and for the nation as a whole electrokinetic remediation is one possible technique for in situ removal of such contaminants from unsaturated soils. Large spills and leaks can contaminate both the soil above the water table as well as the aquifer itself. Electrodes are implanted in the soil, and a direct current is imposed between the electrodes. The application of direct current leads to a number of effects: ionic species and charged particles in the soil water will migrate to the oppositely charged electrode (electromigration and electrophoresis), and concomitant with this migration, a bulk flow of water is induced, usually toward the cathode (electroosmosis). The combination of these phenomena leads to a movement of contaminants toward the electrodes. The direction of contaminant movement will be determined by a number of factors, among which are type and concentration of contaminant, soil type and structure, interfacial chemistry of the soil-water system, and the current density in the soil pore water. Contaminants arriving at the electrodes may potentially be removed from the soil by one of several methods, such as electroplating or adsorption onto the electrode, precipitation or coprecipitation at the electrode, pumping of water near the electrode, or complexing with ion-exchange resins. Experimental results are described on the removal of sodium dichromate and food dye from soil.

5203 (WSRC-MS–92-305) **A mobile autonomous robot for radiological surveys.** Dudar, A.M.; Wagner, D.G.; Teese, G.D. Westinghouse Savannah River Co., Aiken, SC (United States). [1992]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-921102–22: Joint American Nuclear Society (ANS)/European Nuclear Society (ENS) international meeting on fifty years of controlled nuclear chain reaction: past, present, and future, Chicago, IL (United States), 15-20 Nov 1992). Order Number DE93000366. Source: OSTI; NTIS; INIS; GPO Dep.

The Robotics Development Group at the Savannah River Site is developing an autonomous robot (SIMON) to perform radiological surveys of potentially contaminated floors. The robot scans floors at a speed of one-inch/second and stops, sounds an alarm, and flashes lights when contamination in a certain area is detected. The contamination of interest here is primarily alpha and beta-gamma. The robot, a Cybermotion K2A base, is radio controlled, uses dead reckoning to determine vehicle position, and docks with a charging station to replenish its batteries and calibrate its position. It uses an ultrasonic ranging system for collision avoidance. In addition, two safety bumpers located in the front and the back of the robot will stop the robots motion when they are depressed. Paths for the robot are preprogrammed and the robots motion can be monitored on a remote screen which shows a graphical map of the environment. The radiation instrument being used is an Eberline RM22A monitor. This monitor is microcomputer based with a serial I/0 interface for remote operation. Up to 30 detectors may be configured with the RM22A.

0550 Safeguards, Inspection, and Accountability

5204 (IS–5076) **Application of high-resolution laser spectroscopy to the monitoring of vapor-phase metals.** Lipert, R.J.; Wang, Z.M.; Schuler, R.; Edelson, M.C. Ames Lab., IA (United States). Oct 1992. 41p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-82. Order Number DE93004432. Source: OSTI; NTIS; INIS; GPO Dep.

Research conducted in the Ames Laboratory Nuclear Safeguards and Security Program is reviewed. Progress in applying high-resolution laser spectroscopy to the monitoring of vapor-phase metals is described. The spectroscopic techniques employed include fluorescence excitation in an atomic beam, laser atomic absorption in a heat-pipe oven and atomic beam, Doppler-free saturated absorption in a heat-pipe oven, and Doppler-free polarization spectroscopy for the stabilization of the laser wavelength.

5205 (LA–12374-MS) **SNM holdup measurements for Los Alamos exhaust ducts, Interim Phase 2 report.** Marshall, R.S. Los Alamos National Lab., NM (United States). Sep 1992. 61p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93001652. Source: OSTI; NTIS; INIS; GPO Dep.

Quantitative (Phase II) holdup measurements were made on ventilation exhaust ducts at three Los Alamos facilities to assess the quantity of fissile material deposited inside the ducts. The ducts requiring rigorous, quantitative measurements were identified through a comprehensive but less quantitative Phase I measurement program. From the Phase I and II measurements, ducts servicing two rooms at TA-21 (DP Site) are estimated to contain 385 g of ^{235}U(room 313) and 381 g of ^{235}U (room 413R). Uncertainties in these estimates are discussed in detail and are assigned one standard deviation values of 153 g of ^{235}U for room 313 and 139 g of ^{235}U for room 413R. These ducts are in rooms that have been inactive since 1985 and are scheduled and funded for removal in 1992 or 1993. The one room identified at TA-55, PF-4 for Phase II measurement has been measured and the estimated duct holdup is 39 g of ^{239}Pu with a one standard deviation uncertainty of 28 g. Fissile material holdup has also been estimated from Phase I and Phase II measurements on lengthy ducts servicing three rooms at TA-3/SM-29 (CMR Building). These room ducts are estimated to contain a maximum fissile holdup of 345 (room 4023), 119 (room 4034), and 88 (room 5034) g of ^{235}U. With the exception of one segment of duct (estimated to contain 0.8 g of ^{239}Pu), no ducts displayed gamma spectra from fissile isotopes.

5206 (LA–12468-MS) **Comparison of shuffler data analysis techniques.** Rinard, P.M. (Los Alamos National Lab., NM (United States)); Passard, C.; Bignan, G. Los Alamos National Lab., NM (United States). Dec 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93004788. Source: OSTI; NTIS; INIS; GPO Dep.

The hardware for shufflers from Los Alamos and Cadarache is very similar, but the data collection and analysis techniques are quite different. The physics of delayed neutrons is sufficiently complex to make an analytical comparison difficult, so we compared the shufflers numerically using measured data. The Los Alamos shuffler algorithm computes the average delayed-neutron count rate, whereas the Cadarache algorithm fits a delayed-neutron decay curve to the time-decay data and finds the amplitude of the curve. The amplitude is another way to express an average because it is the result of fitting a curve to the data using a least-squares process. The Los Alamos shuffler's background rate is measured before the irradiation and the delayed-neutron counting and then subtracted from the delayed-neutron count. The Cadarache background is calculated as part of the fit to the decay curve, but it is not used in the rest of the analysis. Delayed-neutron data from two experiments at Cadarache were used for the comparison. One set of data had high count rates from many grams of ^{235}U in simulated sludge; the other set had low count rates from solutions with milligrams of ^{239}Pu. The low-count-rate data tested the abilities of the techniques to function with a low signal-to-noise ratio. Each step of the two data analysis techniques was analyzed to compare the operations. Calibration curves were produced from each technique and used to calculate interpolated values. The relative precisions and accuracies of the interpolated values were compared and, after taking into account the nonoptimum irradiation and count times for the Cadarache technique, the results were virtually identical. The calculated amplitude was not always as precise as the count rate, but lack of precision in interpolated values was dominated by uncertainties in the calibration parameters.

5207 (WHC-SA–1446) **Nuclear material accounting: The next generation.** Kern, E.A. (Los Alamos National Lab., NM (United States)); McRae, L.P.; O'Callaghan, P.B.; Yearsley, D. Westinghouse Hanford Co., Richland, WA (United States). Jul 1992. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-9207102–71: Institute of Nuclear Materials Management (INMM) annual meeting, Orlando, FL (United States), 19-22 Jul 1992). Order Number DE93001675. Source: OSTI; NTIS; INIS; GPO Dep.

The Westinghouse Hanford company (Westinghouse Hanford) and the Los Alamos National Laboratory (LANL) have undertaken a joint effort to develop a new generation material accounting system. The system will incorporate the latest advances in microcomputer hardware, software, and network technology. This system, the Local Area Network Material Accounting System (LANMAS), offers greater performance and functionality at a reduced overall cost. It also offers the possibility of establishing a standard among DOE and NRC facilities for material accounting. This report provides a discussion of this system.

0560 Legislation and Regulations

Refer also to citation(s) 5111, 5144, 5436, 5437, 5438, 5439, 5440, 6677

5208 (DOE/EGD-RCRA–002/0690) **Closure of hazardous and mixed radioactive waste management units at DOE facilities.** USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (United States). RCRA/CERCLA Div. Jun 1990. 278p. Sponsored by USDOE, Washington, DC (United States). Order Number DE91009494. Source: OSTI; NTIS; INIS; GPO Dep.

This is document addresses the Federal regulations governing the closure of hazardous and mixed waste units subject to Resource Conservation and Recovery Act (RCRA) requirements. It provides a brief overview of the RCRA permitting program and the extensive RCRA facility design and operating standards. It provides detailed guidance on the procedural requirements for closure and post-closure care of hazardous and mixed waste management units, including guidance on the preparation of closure and post-closure plans that must be submitted with facility permit applications. This document also provides guidance on technical activities that must be conducted both during and after closure of each of the following hazardous waste management units regulated under RCRA.

5209 (INIS-XN–394) **17 SEPTEMBRE 1991-Ministerial Order amending the Ministerial Order of 24 April 1964 on**

approval of a type of equipment containing radioactive substances, made in implementation of section 3.1.d/2 of the Royal Order of 28th February 1963 laying down general regulations for protection of the public and workers against the hazards of ionizing radiation. Belgium. 13 Dec 1991. [1] (In French, Dutch). Order Number DE93609753. Source: OSTI; NTIS (US Sales Only); INIS.

This order amends the licensing procedure for a type of radiation emitting equipment, in particular, the technical checks will henceforth be made by the public health authorities. (NEA).

5210 (INIS-XN–398) **27 September 1991-Royal Order establishing an emergency plan for nuclear risks on Belgian territory.** Belgium. 21 Jan 1992. [36] (In French). Order Number DE93609754. Source: OSTI; NTIS (US Sales Only); INIS.

This emergency plan is to serve as guidance for the protection measures to be taken whenever necessary. It establishes the duties of the different services and bodies, in accordance with their responsibilities under the national laws and regulations. The plan, which describes the general organisation, must be supplemented by intervention plans at the different action levels: by the provincial authorities, the communal authorities and the various services and institutions concerned. This plan mainly concerns large nuclear installations and transport of nuclear fuels and radioactive materials; however, lower risks from other activities are also covered. (NEA).

5211 (INIS-XN–399) **6 September 1991-Royal Order amending the Royal Order of 28 February 1963 laying down general regulations for protection of the public and workers against the hazards of ionizing radiation.** Belgium. 5 Oct 1991. [3] (In French, Dutch). Order Number DE93609755. Source: OSTI; NTIS (US Sales Only); INIS.

The 1963 Royal Order has been amended by this Order to take into account Community Directive 89/618/Euratom on informing the general public about health protection measures and steps to be taken in the event of a radiological emergency. (NEA).

5212 (INIS-XN–405) **Act No 142-19 February 1992. Provisions for implementing Italy's obligations stemming from its membership in the European Community (Community law for 1991).** Italy. 20 Feb 1992. [5] (In Italian). Order Number DE93609757. Source: OSTI; NTIS (US Sales Only); INIS.

This Act takes into account Directive 89/618/Euratom of 27 November 1989 of the Council of the European Communities on informing the general public about health protection measures to be applied and steps to be taken in the event of a radiological emergency. (NEA).

5213 (INIS-XN–406) **Entry into force of the Convention on the Physical Protection of Nuclear Materials, signed in Vienna on 3 March 1980.** Italy. 1991. [1] (In Italian). Order Number DE93609771. Source: OSTI; NTIS (US Sales Only); INIS.

Italy ratified the Convention on the Physical Protection of Nuclear Material on 6 October 1991. This text announces the entry into force of the Convention for Italy on that date. (NEA).

5214 (INIS-XN–408) **3084 ROYAL DECREE No 53/1992 of 24 January 1992 approving the Regulation on Health Protection against Ionizing Radiation.** Spain. 12 Feb 1992. [54] (In Spanish). Order Number DE93609758. Source: OSTI; NTIS (US Sales Only); INIS.

An English translation is provided.

The purpose of this new Regulation is to unite in a single instrument the existing rules on this subject contained in Decree 2519/1982 as amended by Decree 1753/1987, now repealed, as well as to introduce certain modifications which have proved desirable in the light of the practical application of those rules. The 1987 Decree reflected the basic safety standards of the Euratom Directives. Like that Decree, the new regulation lays down the measures for protection of the public and occupationally exposed persons against the dangers of ionizing radiation. The Regulation is supplemented by Appendices providing for definitions of radiological, biological and medical terms, annual dose limits for the public and for occupationally exposed persons, etc. (NEA).

5215 (INIS-XN–409) **171 ROYAL DECREE 1891/1991 of 30 December 1991 on the installation and use of X-ray equipment for the purposes of medical diagnosis.** Spain. 3 Jan 1992. [3] (In Spanish). Order Number DE93609759. Source: OSTI; NTIS (US Sales Only); INIS.

An English translation is provided.

The Decree lays down the rules enabling government authorities to monitor the proper functioning of such appliances. It takes account of the Council of European Communities' Directive 80/836/Euratom amended by Directive 84/466/Euratom on basic safety standards for the health protection of the general public and workers against the dangers of ionization and Directive 84/467/Euratom laying down basic measures for the radiation protection of persons undergoing medical examination or treatment. The Decree provides for a register of firms authorised to sell and maintain medical X-ray equipment, and a register of the equipment installed. It also sets out requirements relating to third party liability insurance, and to the qualifications and training of personnel operating the equipment. (NEA).

5216 (INIS-XN–411) **The regulations of the Swedish Radiation Protection Institute concerning Sunlamps (SSI FS 1991:4).** Sweden. 22 Mar 1991. [3] Translated from swedish. Order Number DE93609760. Source: OSTI; NTIS; INIS.

These Regulations apply to cosmetic and medical sunlamps and lay down provisions governing their sale, transfer and disposal. (NEA).

5217 (KEMI–13-91) **Exposure limits - what they mean and how they are used by the authorities.** Victorin, K. National Chemicals Inspectorate, Solna (Sweden). 1991. [84] (In Swedish). Order Number DE93609761. Source: OSTI; NTIS; INIS.

The report describes how several swedish authorities apply exposure limits for chemicals and radiation and many examples are given on how specific exposure limit have been decided.

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0701 Physical Isotope Separation

5218 (PUC-RT–104/89) **Research of catalysts for isotope enrichment of deuterium oxide in water.** Teixeira, L.A. (Pontificia Univ. Catolica do Rio de Janeiro, RJ (Brazil)); Kohler, H.M.; Tavares, L.Y.; Makay Junior, N. Pontificia Univ. Catolica do Rio de Janeiro, RJ (Brazil). Jun 1989. [31] (In Portuguese). Order Number DE93609325. Source: OSTI; NTIS (US Sales Only); INIS.

The preparation of catalysts for isotope enrichment of deuterium oxide in water from hydrogen-water contact systems combined with electrolysis is described. (author).

0702 Radiation Sources

Refer also to citation(s) 5910, 7014

5219 (ANL/MSD/CP–77538) **Synthesis of nanocrystalline materials by electron beam evaporation.** Eastman, J.A. (Argonne National Lab., IL (United States)); Thompson, L.J.; Marshall, D.J. Argonne National Lab., IL (United States). Sep 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-920947–3: Conference on nanostructured materials, Cancun (Mexico), 21-25 Sep 1992). Order Number DE93002910. Source: OSTI; NTIS; GPO Dep.

A new nanophase materials preparation system using electron beam heating to vaporize materials in inert or reactive gaseous environments has been developed. With this system a wide variety of materials can be produced in nanophase form with minimum contamination. Besides enabling the production of pure metals, including refractory materials, the system is designed to produce alloys and multicomponent materials by simultaneous evaporation of two or more elements. The electron beam position and dwell time are set by computer, allowing great control of the evaporation conditions. Results obtained to-date indicate great promise for obtaining increased yields and smaller grain sizes than typically obtainable when nanophase materials are produced using resistive

heating. A description of nanophase γ-Al_2O_3 produced with a mean grain size of approximately 2.5 nm is given as a demonstration of the capabilities of the system.

5220 (BNL–47763) **Proceedings of the TMS symposium on radiation facilities and defect studies.** Snead, C.L. Jr. (ed.). Brookhaven National Lab., Upton, NY (United States). [1992]. 402p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-920305–: Minerals, Metals, and Materials Society (TMS) annual meeting and exhibition, San Diego, CA (United States), 1-5 Mar 1992). Order Number DE93002965. Source: OSTI; NTIS; INIS; GPO Dep.

Intent of the symposium is to highlight the various means of producing and characterizing irradition-induced defects in materials of interest in nuclear appiications. Viewgraphs are presented for 18 papers. Separate abstracts were prepared for the data base.

5221 (INIS-BR–3064) **Nondestructive detection system of faults in fuses using radioisotope.** Goncalves, D. Instituto de Pesquisas Espaciais (INPE), Sao Jose dos Campos, SP (Brazil). 1973[60] (In Portuguese). Order Number DE93609329. Source: OSTI; NTIS (US Sales Only); INIS.

A system is developed to show the viability of non-destructive detection of the faults of explosive safety fuses which are manufactured by Fabrica da Estrela do Ministerio do Exercito. The faults are detected by an ion-chamber based on the variation of the intensity of the beta particles that penetrate the fuse which passes through a collimator. The beta particles are emitted by Strontium-90 + Yttrium-90 encapsulated in either stainless steel or aluminum. The concept of 'bucking Voltage' is applied to differentiate electronically the signal generated by the ion-chamber. (author).

5222 (INIS-BR–3103) **The influence of radiolytic sensitizers in natural rubber latex vulcanization induced by ionizing radiation.** Guedes, S.M.L. (Instituto de Pesquisas Energeticas e Nucleares (IPEN), Sao Paulo, SP (Brazil)); Souza, A. de. Associacao Brasileira de Polimeros, Sao Paulo, SP (Brazil). 1991[5] (In Portuguese). (CONF-9111280–: 1. Brazilian Congress on Polymers, Sao Paulo (Brazil), 5-7 Nov 1991). Order Number DE93609335. Source: OSTI; NTIS (US Sales Only); INIS.

This work made on radiation vulcanization of natural rubber latex process by gamma rays from ^{60} Co source and electron beam of 1.5 MeV, 25 m A by Dynamitron, instead of classic process using sulfur. The experiment was carried out to study the influence of sensitizers (C Cl_4 and n-butyl acrylate) and was reported the vulcanization dose for each sensitizers, related to maximum tensile strength. The results show the possibility to introduce the volatile sensitizer (n-butyl acrylate) instead of C Cl_4 (toxic) in industry applications. (author).

5223 (INIS-BR–3104) **Alternative vulcanization process of natural rubber latex induced by ionizing radiation.** Guedes, S.M.L. (Instituto de Pesquisas Energeticas e Nucleares (IPEN), Sao Paulo, SP (Brazil)). Associacao Brasileira de Polimeros, Sao Paulo, SP (Brazil). 1991[7] (In Portuguese). (CONF-9111280–: 1. Brazilian Congress on Polymers, Sao Paulo (Brazil), 5-7 Nov 1991). Order Number DE93609336. Source: OSTI; NTIS (US Sales Only); INIS.

The natural rubber latex was vulcanized by two different process: (a) thermal process in the presence of sulfur; (b) alternative process using radiation (gamma rays and electrons beam). The comparative study of rubber goods quality (surgical gloves and balloons) was carried out by physical and chemical properties of pre vulcanized latex and physical and mechanics properties of rubber goods for two process. (author).

5224 (INIS-BR–3108) **Chemical effects of ionizing radiations and electron beam in polymers: industrial uses.** Yamasaki, M.C.R. (Instituto de Pesquisas Energeticas e Nucleares (IPEN), Sao Paulo, SP (Brazil)); Reis, R.V.V. dos; Araujo, E.P. Associacao Brasileira de Polimeros, Sao Paulo, SP (Brazil). 1991[5] (In Portuguese). (CONF-9111280–: 1. Brazilian Congress on Polymers, Sao Paulo (Brazil), 5-7 Nov 1991). Order Number DE93609337. Source: OSTI; NTIS (US Sales Only); INIS.

The results obtained from the development PVC dose indicator films, from the PE and PP hydrophilization and from the formulations of crosslink able resins and curable inks and varnishes by radiation, are herein discussed. (author).

5225 (LA-UR–92-3496) **Magnetically insulated ion diodes for synthesis of advanced materials.** Faehl, R.J.; Rej, D.J. Los Alamos National Lab., NM (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-921116–14: 12. international conference on the application of accelerators in research and industry, Denton, TX (United States), 2-5 Nov 1992). Order Number DE93003747. Source: OSTI; NTIS; INIS; GPO Dep.

Magnetically insulated ion diode technology has been used to generate intense ion beams. We have used such beams to form ablation plasmas from solid targets. Initial experiments have studied congruent deposition of complex stoichiometric thin films. Typical ion diode parameters are 400 kV and 50 kA ion beams over a pulse length of 0.5–1.0 μs. Diode operation has been modeled with 2.5-D particle-in-cell simulations. These calculations allow us to unfold the dynamics of electron flow, ion flow, and their interactions to recover time-dependent impedance behavior which is in good agreement with data. Transport of the dense ion flow through an extraction section of the diode requires a high degree of charge neutralization. Self-consistent neutralization dynamics have been modeled with the simulations. We present the latest numerical results and compare them with data from the ongoing experiments.

5226 (LA-UR–92-3506) **Dense plasma focus powered by flux compression generators.** Fowler, C.M.; Freeman, B.L.; Caird, R.S.; Erickson, D.J.; Garn, W.B. Los Alamos National Lab., NM (United States). [1992]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9105399–1: International conference on progress and applications of plasma focus research, Hoboken, NJ (United States), 27-31 May 1991). Order Number DE93003781. Source: OSTI; NTIS; INIS; GPO Dep.

A short summary is given of earlier Los Alamos work in which a Dense Plasma Focus was powered by Flux Compression Generators. Neutron yields obtained in the shot series scaled well with the fifth power of the current. The shot parameters were modeled surprisingly well through the plasma rundown phase by a simple snowplow model. It is shown, with the use of this model, that DPF currents in excess of 10 MA should be obtained with existing generators and initial energy sources. One new element is needed – a high energy opening switch such as a fuse. Much more is known about fuse operation since the Los Alamos program was stopped, so development of this component should be relatively straightforward. If the yield-current scaling relation holds to this current level, then D-T neutron yields in excess of 10^{16} per burst would result, sufficient for some interesting pulsed radiography applications that involve rapidly moving components. Finally, in a sheer flight of fancy, it is shown that D-T yields approaching 10^{20} could be obtained, using FCGs not too much beyond the state of the art, provided the simple modeling and neutron-current scaling relations continue to hold, a rather unlikely supposition.

5227 (LA-UR–92-3710) **The Los Alamos Trailmaster Program: Status and plans.** Goforth, J.H. (Los Alamos National Lab., NM (United States)); Anderson, W.E.; Bartsch, R.R.; Benage, J.F.; Bowers, R.L.; Brownell, J.H.; Cochrane, J.C.; Fenstermacher, C.A.; Foreman, L.R.; Forman, P.R.; Fowler, C.M.; Greene, A.E.; Gribble, R.F.; Kruse, H.WLos Alamos National Lab., NM (United States). [1992]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-921133–2: 6. international conference on megagauss magnetic field generation and related topics, Albuquerque, NM (United States), 9-12 Nov 1992). Order Number DE93003778. Source: OSTI; NTIS; INIS; GPO Dep.

Los Alamos foil implosion program, Trailmaster, continues with its long-term goal of developing a plasma z-pinch that will produce large quantities of soft x-rays. In addition, we are currently considering ways to increase the scope of our activities utilizing the pulsed power capabilities we have developed. Our program combines a large variety of endeavors, including the development of materials fabrication techniques, explosives systems, computational codes, conventional capacitor banks, explosive pulsed power systems,

and plasma diagnostics techniques. In this paper, we will describe how these activities are combined in the framework of three major thrusts that work together to achieve the final goal. We will first note our computational capabilities, and then describe Trailmaster capacitor bank facilities, focusing on recent results and a new facility. Finally, the explosive pulsed power system with which we are currently experimenting will be discussed and we will describe a proposed explosive pulsed power system capable of producing ~5-MJ implosion kinetic energy. Frequently in this paper, we will present the essence of some facet of our program and reference other papers in this conference where more details can be found.

0703 Isotopic Power Supplies

5228 (CTA-IEAV-RI–011/85) **Nuclear energy in the space: panorama 1985.** Corcuera, R.P. Centro Tecnico Aeroespacial (CTA-IEAv), Sao Jose dos Campos, SP (Brazil). Inst. de Estudos Avancados. 27 Nov 1985. [29] (In Portuguese). Order Number DE93609327. Source: OSTI; NTIS (US Sales Only); INIS.

A panoramic view of different areas where nuclear energy can be applied in space is given. These are: radioisotope thermoelectric generators, nuclear reactors for space stations, space crafts and air crafts. The principal difficulties are pointed out and the safety aspect is emphasized. (author).

0704 Economic, Industrial, and Business Aspects

5229 (KFK–5055) **Tritium.** Fiege, A. (comp.). Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Kernfusion. Jul 1992. 229p. (In German). Order Number DE93742918. Source: OSTI; NTIS (US Sales Only); INIS.

This report contains information on chemical and physical properties, occurence, production, use, technology, release, radioecology, radiobiology, dose estimates, radioprotection and legal aspects of tritium. The objective of this report is to provide a reliable data base for the public discussion on tritium, especially with regard to its use in future nuclear fusion plants and its radiological assessment. (orig.).

0706 Environmental Aspects

Refer also to citation(s) 6612

08 HYDROGEN

Refer also to citation(s) 4971

0801 Production

Refer also to citation(s) 5277

5230 (DOE/ER/81057–93/C0107) **Biological production of hydrogen.** Clausen, E.C.; Gaddy, J.L.; Ko, C.W. Engineering Resources, Inc., Fayetteville, AR (United States). [1992]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-90ER81057. (CONF-920951–15: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93002604. Source: OSTI; NTIS; GPO Dep.

All Phase I objectives were satisfactorily achieved. Stoichiometric yields of hydrogen were obtained from CO with R. rubrum. Fast growth was observed on synthesis gas only; however, growth was maximized with a small amount of yeast extract at 30°C and pH 7. Intrinsic kinetic parameters were determined and showed that fast hydrogen production rates are possible. The Phase II research program concentrated on defining the optimal culture and bioreactor for hydrogen production. To insure that the best possible system was developed, cultures were screened for enzyme activity and hydrogen production. Promising cultures were optimized for hydrogen yield and CO conversion. Bioreactors that achieved high mass transfer rates, as well as high cell concentrations, were studied. Advanced bioreactor concepts, such as solid-state fermentation, non-aqueous fermentation, and high pressure fermentation were applied to these reactors to enhance mass transport. Process design and economic evaluations of the various alternatives were used to guide the research program. A new bacterial culture has been isolated from natural sources which consumes CO rapidly and gives high hydrogen yields. The new isolate, ERIH2, is able to utilize a variety of sugars as growth substrates and, unlike R. rubrum, does not require light for growth. The yield of H_2 by ERIH2 reach 100 percent. Typical H_2 yields by R. rubrum were 75–85 percent.

5231 (DOE/MC/10637–93/C0119) **Production of hydrogen and coproducts from coal.** Hauserman, W.B. North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center. [1992]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC21-86MC10637. (CONF-920951–31: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93002608. Source: OSTI; NTIS; GPO Dep.

Between the TGA and CPU data, a number of general conclusions have been developed, regarding both selection of catalysts and selection of the most effective and economic approaches to scaled-up process development. (Hauserman, 1992) These conclusions are in an order that is not meant to imply relative importance. (1) Impregnation of Wyodak coal with KOH, at a potassium-to-fixed carbon ratio of around 0.2 or greater, roughly doubles the gasification reaction rate in fluidized beds of limestone. Soluble potassium, in any convenient form, is recommended as a rate-enhancing catalyst, subject to supply costs and efficiency of recovery by leaching. (2) In a fluidized bed of taconite, the reaction rate enhancement by potassium impregnation appears at least as great as in a limestone bed. (3) Reactivity coefficients defined by continuous test results are a different but closely related property and are substantially lower than standard TGA-determined reactivities. (4) The most useful result from the CPU is determination of specific capacities, defined as pounds per hour of fixed carbon converted per volume of reaction vessel. (5) Potassium impregnation clearly enhances reaction rates, but in a practical process will require an efficient leaching step for potassium recovery to be economically viable. (6) Earlier TGA results suggest that a weight ratio of potassium to fixed carbon (FC) of roughly 0.4 will give maximum reactivity enhancement. (7) For these CPU tests, control over the actual degree of potassium impregnation during feed impregnation proved more difficult than expected, apparently leaving a lot of the KOH catalyst free (non-ion exchanged) and subject to segregation during handling and feeding, as well as in the gasifier itself.

0807 Products and By-Products

Refer also to citation(s) 5232

0830 Combustion

5232 (VTT-TIED–1321) **Catalytic combustion of hydrogen.** Tonteri, H. (Technical Research Centre of Finland, Espoo (Finland). Metals Lab.); Taehtinen, S. Technical Research Centre of Finland, Espoo (Finland). 1992. 37p. (In Finnish). Order Number DE93752854. Source: OSTI; NTIS.

Hydrogen catalytic combustors are advantageous because they release heat at lower temperatures than flame combustors. Low operation temperature and flameless burning make the process safe. The combustion temperature can be controlled continuously by changing the hydrogen flow rate. Combustion gas of hydrogen catalytic combustor is water vapour, and if burned with air certain amounts of nitrogen oxides may also occur. Commercial applications are nowadays gas monitors for combustible gases. Applications of hydrogen catalytic combustion are predicted to increase in households heaters, cooking devices and industrial drying and heating processes. Further research of hydrogen catalytic combustors is concentrated on increasing their power and reliability in running. The literature review of this report describes catalytic combustion and especially hydrogen catalytic combustion. The construction of hydrogen catalytic combustor and different catalytic materials are explained. Some examples of commercial or near

commercial applications are shown. An experimental construction was built to tentative run an open catalytic combustor, 50 W. The maximum operation temperature 164 deg C was reached with hydrogen flow rate 15 l/h. The temperature was easily controlled by changing hydrogen flow rate. The combustion efficiency reached in these tests was 95 %.

09 BIOMASS FUELS

Refer also to citation(s) 4971

0908 Production

5233 (ETDE-mf–93744305) **Renewable resources - results of plantation experiments with Miscanthus and Arundo donax.** Informationen fuer die Pflanzenproduktion. Schweiger, P.; Oster, W. Landesanstalt fuer Pflanzenbau Forchheim, Rheinstetten (Germany); Ministerium fuer Laendlichen Raum, Ernaehrung, Landwirtschaft und Forsten, Stuttgart (Germany). 1991 40p. (In German). Order Number DE93744305. Source: OSTI; NTIS (US Sales Only).

In cooperation with Energieversorgung Schwaben of Stuttgart (EVS), the Landesanstalt fuer Pflanzenbau (LAP) at Forchheim started an experiment on the growth of reeds for several years duration. Species used were Miscanthus sinensis and Arundo donax as well as a late-ripening type of maize for comparison purposes. The results of the first two years of the experiment can be summarized as follows: While the reed plants yielded very little biomass in the year of plantation, the yield of dry mass was increased considerably during the second year of cultivation to 21.3 tonnes per hectare for Miscanthus and 16.8 tonnes per hectare for Arundo donax (harvesting time: February). Maize yielded a constant 17 tonnes per hectare in both years. (orig./EF) With 7 tabs., 6 figs.

5234 (SLU-ST-UPPRLT–222) **The long bundler: Development and testing of a machine for bundling of small trees.** Berglund, B.; Gullberg, T.; Johannesson, A.; Synwoldt, U.; Saell, H.O. Swedish Univ. of Agricultural Sciences, Garpenberg (Sweden). Dept. of Operational Efficiency. 1991. 48p. (In Swedish). Order Number DE93753072. Source: OSTI; NTIS.

With 2p English summary.

Compression and bundling forest fuels into suitable units is an alternative to chipping. Bundling can be expected to be associated with considerably better storage possibilities, due to more thorough drying and lowered risk for microbial decomposition. To test the potential of bundling, as well as to explore the handling and storage characteristics of bundles, a test rig - "Long Bundler" - was developed which produces bundles with a length of 3 meters and a diameter of 30-40 cm. The bundling process was designed as an almost continuous flow of material through the machine, from feeding of raw material, through compression and binding, to cross-cutting of the finished bundle. The report describes the development of a test rig, time studies of bundling with manual feeding in clearing stands, studies of transport with a conventional timber truck as well as storage and burning of bundles. The produced bundles had an average weight of almost 110 kg which corresponds to 0.114 m^3 (solid) biomass per bundle. The percentage of solid volume was calculated to 37.7 per cent. With one person manoevring the machine and another dragging and loading the clearing wood (diameter 3-5 cm), a performance of 10-12 bundles per work-hour was obtained. The manual feeding of the material is a bottleneck in the system. The theoretical maximum performance is approximately 80 bundles per hour. A storage trial over a period of three summers showed that the average moisture content of the bundles was as low as 22%. Simple fuel-value studies involving whole bundles showed that the bundles burn very quickly. (18 refs., 16 figs., 9 tabs.).

0909 Processing

Refer also to citation(s) 6519

5235 (CONF-9210197–1) **Papain digestion of crude Trichoderma reesei cellulase: Purification and properties of cellobiohydrolase I and II core proteins.** Woodward, J.; Brown, J.P.; Evans, B.R.; Affholter, K.A. Oak Ridge National Lab., TN (United States). [1992]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Department of Energy (DOE) ethanol from biomass annual review meeting; Golden, CO (United States); 28-29 Oct 1992. Order Number DE93002423. Source: OSTI; NTIS; GPO Dep.

Papain digestion of a crude Trichoderma reesei cellulose preparation followed by gel filtration on a Superdex column resulted in the separation of cellobiohydrolase (CBH) I and II core proteins (cp). They were further purified to apparent homogeneity by chromatofocusing. N-terminal protein sequencing of the CBH II cp preparation confirmed its identity. A comparison of the catalytic activity and cellulose-binding ability of these core proteins was made. The major differences between them were the findings that CBH II cp possessed a sixfold higher specific activity toward p-nitrophenylcellobioside than the native CBH II preparation and still bound to microcrystalline cellulose, unlike CBH I cp. Neither CBH I cp nor CBH II cp had activity toward carboxymethylcellulose, but both were able to hydrolyze barley b-glucan. These data suggest that removal of the cellulose-binding domain and hinge region from CBH I and II have different effects on their properties.

5236 (DOE/CE/27504–11) **Waste tire recycling by pyrolysis.** Urban Consortium for Technology Initiatives (United States). Energy Task Force; Public Technology, Inc., Washington, DC (United States); New Orleans Office of Housing and Urban Affairs, LA (United States). Oct 1992. 116p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90CE27504. Order Number DE93005618. Source: OSTI; NTIS; GPO Dep.

This project examines the City of New Orleans' waste tire problem. Louisiana State law, as of January 1, 1991, prohibits the knowing disposal of whole waste tires in landfills. Presently, the numerous waste tire stockpiles in New Orleans range in size from tens to hundreds of tires. New Orleans' waste tire problem will continue to increase until legal disposal facilities are made accessible and a waste tire tracking and regulatory system with enforcement provisions is in place. Tires purchased outside of the city of New Orleans may be discarded within the city's limits; therefore, as a practical matter this study analyzes the impact stemming from the entire New Orleans metropolitan area. Pyrolysis mass recovery (PMR), a tire reclamation process which produces gas, oil, carbon black and steel, is the primary focus of this report. The technical, legal and environmental aspects of various alternative technologies are examined. The feasibility of locating a hypothetical PMR operation within the city of New Orleans is analyzed based on the current economic, regulatory, and environmental climate in Louisiana. A thorough analysis of active, abandoned, and proposed Pyrolysis operations (both national and international) was conducted as part of this project. Siting a PMR plant in New Orleans at the present time is technically feasible and could solve the city's waste tire problem. Pending state legislation could improve the city's ability to guarantee a long term supply of waste tires to any large scale tire reclamation or recycling operation, but the local market for PMR end products is undefined.

5237 (DOE/ER/12117–2) **Cationically polymerizable monomers derived from renewable sources: Annual performance report.** Crivello, J.V. Rensselaer Polytechnic Inst., Troy, NY (United States). Dept. of Chemistry. 1 Oct 1992. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER12117. Order Number DE93005926. Source: OSTI; NTIS; GPO Dep.

The objectives of this project are to design and synthesize novel monomers which orginate from renewable biological sources and to carry out their rapid, efficient, pollution-free and energy efficient cationic polymerization to useful products under the influence of ultraviolet light or heat. A summary of the results of the past year's research on cationically polymerizable monomers derived from renewable sources is presented. Three major areas of investigation corresponding to the different classes of naturally occurring starting materials were investigated; epoxidized terpenes and natural rubber and vinyl ethers from alcohols and carbohydrates.

5238 (DOE/ER/13690–5) **[Characterization of lignin and Mn peroxidases from Phanerochaete chrysosporium]:**

Progress report. Pennsylvania State Univ., University Park, PA (United States). [1992]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-87ER13690. Order Number DE93005924. Source: OSTI; NTIS; GPO Dep.

Lignin peroxidases were investigated with respect to enzyme kinetics and NMR spectroscopy of the heme domain. MN peroxidases were studied with respect to the role of oxalate in enzyme activity, the NMR spectroscopy of the heme domain. Gene expression of both lignin and MN peroxidases were examined as well as expression of site-directed mutants aimed at scale up production of these enzymes.

5239 (ETDE-mf–93744391) **Recovery of high-grade SNG-methane from sewage gas by desulfurization with activated carbon and CH_4/CO_2-separation with CMS-based PSA. Final report.** Pilarczyk, E. (DMT-Institut fuer Waerme- und Stromerzeugung, Essen (Germany)); Mellech, L. DMT-Gesellschaft fuer Forschung und Pruefung mbH, Essen (Germany); Bundesministerium fuer Forschung und Technologie, Bonn (Germany). May 1992 47p. (In German). Contract BMFT 02WS8910. Order Number DE93744391. Source: OSTI; NTIS (US Sales Only).

An adsorption pilot plant for recovery of high grade SNG-methane from sewage gas was operated at a German sewage treatment plant. For purification hydrogen sulfide was removed from sewage gas by catalytic oxidation to elemental sulfur using KJ-impregnated activated carbon as catalyst and sulfur adsorbent. The spent sulfur loaded activated carbon was regenerated by external heating with hot air. Sewage gas was completely desulfurized, the H_2S-content was dropped from 2-10 g/m^3 to <1 mg/m^3. After purification carbon dioxide was separated from methane by adsorption onto a carbon molecular sieve in a PSA-plant. Methane with a purity of 96-99 % by vol. was recovered as high grade SNG-product with a yield of up to 94%. (orig.) With 21 refs., 10 tabs., 16 figs.

5240 (ETDE-mf–93744439) **Solar village Indonesia. Biotechnologies. Final report.** Yurismono, H.; Budiono, C.; Noetzold, H. Technischer Ueberwachungs-Verein Rheinland e.V., Koeln (Germany); Bundesministerium fuer Forschung und Technologie, Bonn (Germany). [1992] 112p. Contract BMFT BEO 038817. Order Number DE93744439. Source: OSTI; NTIS (US Sales Only).

Within the framework of an bilateral cooperation between the FRG and the Republic of Indonesia the application of systems for solar energy and biomass utilization have been tested and assessed. Two similar wood gasification systems were installed and tested in the farmer's village of Picon. The differed in the cooling and cleaning components. One of them caused problems from the very beginning so it was modified. The first test with the modified system were successful and the amount of contaminated water could largely be reduced. The system was taken over by a saw-mill factory. From the analysis of profitability it can be shown that the application of wood gasifiers in saw-mills under Indonesian condition can compete with Diesel systems. (BWI).

5241 (ETDE-mf–93744441) **Composting of organic wastes in Hesse. Status report as of July 1, 1991.** Umweltplanung, Arbeits- und Umweltschutz. Schriftenreihe der Hessischen Landesanstalt fuer Umwelt. Kummer, V. Hessische Landesanstalt fuer Umwelt, Wiesbaden (Germany). 1991 51p. (In German). Order Number DE93744441. Source: OSTI; NTIS (US Sales Only).

The report intends to inform about and propagate the experiences gained in the composting of organic wastes, thus contributing to the preparation of the regional composting projects which are planned for the near future. Wastes can also be avoided by composting in private households with attached gardens. The report discusses the combination and possibilities of these two vehicles of waste management. (orig.).

5242 (ETDE-mf–93744511) **Xanthane production in the bubble column bioreactor.** Il-Soon Suh. Technische Univ. Braunschweig (Germany). Fakultaet fuer Maschinenbau und Elektrotechnik. 14 May 1992 140p. (In German). Order Number DE93744511. Source: OSTI; NTIS (US Sales Only).

The industrial production of xanthane occurs in batch operation in stirred boiler reactors. The enrichment of the product in the culture medium causes an extreme increase of viscosity during strongly pseudoplastic flow behavior. Because of inhomogeneous distribution of the shear gradient in the stirred boiler, local deviations from the optimal fermentation conditions can occur (temperature, pH, oxygen supply); even stagnant regions may form at the walls. The suitability of tower reactors for xanthane production was investigated in the dissertation. The bubble column is by far superior to other reactor types (airlift, three-phase fluidized bed, stirred boiler, immersion-type beam reactor) with regard to good mixing of highly viscous culture broths of Xanthomonas campestris. The rise of the large bubbles which fill almost the entire column cross-section practically leads to intensive mixing. This not only makes the bubble column suitable for production but allow also the establishment of dependable fundamentals for model formation. (orig./EF).

5243 (ETSU-B–1248) **A review of overseas experience in coarse-RDF production and combustion.** ECOTEC Research and Consulting Ltd., Birmingham (United Kingdom). Feb 1992. 114p. Order Number DE93756632. Source: OSTI; NTIS (US Sales Only).

In 1988 the Energy Technology Support Unit (ETSU) commissioned a review study of Overseas Experience in the Production and Combustion of Coarse Refuse Derived Fuel (c-RDF). The objectives of this review study were to examine the technical and economic performance of facilities manufacturing and burning c-RDF and to assess whether such facilities could operate successfully in the UK. Following an initial desk based review a number of visits to facilities in the US and Europe were undertaken. In addition, meetings were held with some of the key equipment suppliers and national experts in the energy from waste (EFW) field. In 1991 limited further discussions were held to update the findings of the initial study. This report presents both phases as an integrated whole. (author).

5244 (NEI-DK–1021) **Stirring in biogas systems.** Krueger-Bigadan A/S, Soeborg (Denmark). Oct 1992. 140p. (In Danish). Contract ENS-1383/91-0002. Order Number DE93752799. Source: OSTI; NTIS.

EFP-91.

Stirring, or agitating, in Danish biogas systems varies considerably in character even with regard to systems which receive similiar compounds of biomass and are fitted with similiar stirring equipment. In some systems stirring uses a great deal of energy, here the rearrangement of the stirring equipment, or supplementing it, can improve the situation. It is stated that there seems to be a need for the determination of a common energy-economical goal for stirring equipment in biomass conversion plants. On this basis new designs can be developed. New sets of criteria for such designs for mixing systems are presented and the theories on which they are founded are explained. Information is also given on the evaluation of layer stratification in the liquid manure tank, of the mixing in the reactor tank and of the effectivity of the mixing in the fore-tank and in the storage tank. Matters of economy are also dealt with. Diagrams and tables illustrate the detailed text. (AB).

5245 (NREL/TP–421/4978) **Processes for pretreating lignocellulosic biomass: A review.** McMillan, J.D. National Renewable Energy Lab., Golden, CO (United States). Nov 1992. 45p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE93000043. Source: OSTI; NTIS; GPO Dep.

This paper reviews existing and proposed pretreatment processes for biomass. The focus is on the mechanisms by which the various pretreatments act and the influence of biomass structure and composition on the efficacy of particular pretreatment techniques. This analysis is used to identify pretreatment technologies and issues that warrant further research.

0910 Properties and Composition

5246 (SVF–441) **Solid fuels - A round robin test of solid residual products from heating plants.** Burwall, J. (Sveriges Lanbruksuniversitet, Enheten foer Biomassa, Energi- och Fibergroedor, Umeaa (Sweden)); Samuelsson, R. Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden). Mar 1992. 46p. (In Swedish). Order Number DE93753060. Source: OSTI; NTIS.

A round robin test, where six ashes (three coal ashes and three bioashes) were analyzed with respect to 'fuelspecific' parameters, major and minor elements and trace elements, has been carried out. Thirteen laboratories from Sweden, Finland, Denmark and Norway participated and the purpose of the investigation was to compare and evaluate common methods of analysis for ashes. The standard deviation of the used methods was compared to the precision calculated from the reported reproducability in corresponding standard methods for fuels. The results show that, without taking the significant outliers into account, the precision of the analysis of moisture content, hydrogen, nitrogen, sulfur and the predominant part of major and minor elements was of the order of the corresponding analysis for fuels. The analysis of carbon and calorific value showed a variation somewhat higher than that for fuel analysis, while the results for volatile matter and the tracer elements were considerably less precise. The result for the amount of unburned matter showed significant groupings, not only between the ashes but also between the laboratories. The groupings were explained mainly by the different experimental parameters used during the ashing step. (au) (5 refs., 10 figs., 38 tabs.).

0920 Combustion

Refer also to citation(s) 4958, 4963, 4966, 5243, 5351, 5804, 5805, 5827

5247 (CONF-9101154–, pp. 191-208) **Biomass used for power generation.** Weidinger, A. (Bayerisches Staatsministerium fuer Ernaehrung, Landwirtschaft und Forsten, Muenchen (Germany)). Bayerisches Staatsministerium fuer Wirtschaft und Verkehr, Muenchen (Germany). 1991. 306p. (In German). From Symposium on incentives for using renewable energy sources in Bavaria; Coburg (Germany); 28-29 Jan 1991. In *Incentives for using renewable energy sources in Bavaria. Symposium for users and suppliers (local authorities, public utilities, industry, medium enterprises).* Order Number DE93744689. Source: OSTI; NTIS (US Sales Only).

The author reports on a fully automated heating installation fired with fuel annual plants (whole cereal plant) at the Staatliche Versuchsgueterverwaltung. The heart of the plant is a hay tower controlled by the heating system during the feed phase. The tower can accomodate chopped material of a length of c. 10cm. Biomass application in combustion is suggested by the idea of waste disposal in farming. Several conditioning procedures are studied comparatively. Whole plants are harvested best by way of bales which is the most suitable method currently, and are compacted in large presses which, if optimized, results in minimum costs of 350 DM per hectare. (BWI).

5248 (ETSU-B–1284-P1) **Coal - cRDF co-firing. A review of the Courtaulds demonstration project.** Environmental Resources Ltd., London (United Kingdom). 1992. 48p. Order Number DE93756631. Source: OSTI; NTIS (US Sales Only).

The purpose of the Courtaulds project was to demonstrate that pulverised, coarse RDF (cRDF) could be used in conjunction with coal on large chain grate stoker fired industrial boilers. This was one of several cRDF demonstration projects funded by the Department of Energy as part of their "Waste as a Fuel" programme. Section 2 presents a brief summary of the demonstration project, highlighting some of technical and operational/managerial problems which were experienced. Section 3 examines the potential for future replication. It concludes that the problems experienced in the demonstration project can be overcome and that the technology offers scope for future replication. That scope depends on the availability of suitable industrial boilers, and a review of this issue is included. Section 4 contains a conceptual design for future facilities to produce a suitable cRDF and to convert chain grate industrial boilers for its co-combustion with coal. These designs were developed by ERL on the basis both of this demonstration project and of parallel developments in cRDF production. Section 5 sets out both the approach and the results of an economic evaluation, which compared waste disposal by transfer to landfill with the production and use of a cRDF. The economic evaluation is undertaken from the point of view both of the waste disposal operator and of the fuel user. (author).

5249 (NEI-DK–1005) **Experimental firing of Miscanthus at Hjordkaer district heating plant.** Dk-TEKNIK, Aalborg (Denmark). Energi og Miljoe. Jun 1991. 13p. (In Danish). Contract ENS-51161-92.0024;Contract ENS-51161-91.0035. Order Number DE93752806. Source: OSTI; NTIS.

A series of measurements were taken during one day at a local district heating plant which was experimentaly fired with bales of Miscantus. A single measurement, lasting for half an hour, was taken of the emission. During measurement, the after-calculated yield was 69% of the nominal, which is 3.15 MW. The smoke outlet pipes had been previously cleaned and the filter bags inspected. Flue gas temperature was measured to be 91 degrees centigrade, flue gas volume (m^3(n,t)/h) was 3750, carbon dioxide content (volume %, dry basis) was 11.5, oxygen content (ditto) was 8.7, solid state concentration (mg/m^3(n,t) was 42, NO_x concentration as NO_2 (ditto) was 530 and CO concentration (ditto) was 138. (n,t indicates dry flue gas at normal condition, which is 0 degrees centigrade and pressure 1013 mb). The indirect efficiency according to DIN 1942 was 92.8%. Measurements were taken within a period of only half an hour and do not cover the situation where the bale is changed. (AB).

5250 (NEI-DK–1030) **Storage, transport and firing of sliced straw: Firing experiment. Measurements carried out at Hinnerup district heating plant in June and July 1992.** Meldorf, S.; Noerregaard, A. DK-Teknik, Soeborg (Denmark). Oct 1992. 49p. (In Danish). Contract ENS-51161-92.0009. Order Number DE93752978. Source: OSTI; NTIS.

The aim of the experiment on the firing of sliced straw, carried out at a wood-chip district heating plant in Hinnerup, Denmark, was to investigate potentials for the utilization of wet sliced straw as fuel and to evaluate combustion conditions compared to those related to wood chips at this plant. The moisture content did not exceed the average as there had been but little previous rain. The results of the measurements taken are presented. They comprise the emission content of CO_2, O_2, CO, and the content of TOC and water, the temperature of the flue gas, readings from the plant's instruments and the results of the analysis. It is concluded that the grade of energy efficiency obtained was satisfactory when the plant used straw instead of wood chips as fuel. Emission from the combustion of straw was very high in relation to that from wood-chips. Thus the original filter was not effective enough. The amount of odour emitted from straw combustion was about the same as for wood-chips yet it is thought that the strength of the odour in relation to straw combustion can vary significantly. (AB).

5251 (NUTEK-FBT–92-13) **Equilibrium calculations of NO reduction and kinetic calculations of the combustion of biomass fuels in grate firing.** Olanders, B. (Chalmers Univ. of Technology and Univ. of Gothenburg (Sweden). Dept. of Inorganic Chemistry). Swedish National Board for Industrial and Technical Development (NUTEK), Stockholm (Sweden); Chalmers Univ. of Technology and Univ. of Goeteborg, Goeteborg (Sweden). Dept. of Inorganic Chemistry. 1992. 30p. Project NUTEK-276-374. (CTH-OOK–92-04). Order Number DE93753020. Source: OSTI; NTIS.

The objective of this investigation has been to compare theoretical calculations with experimental results from the combustion of biomass fuels in a laboratory fixed bed furnace. The two computer codes used were Fluent and a program for thermochemical equilibrium calculations. In addition to this some experiments were carried out with the addition of NO to the primary combustion air, to examine the ability of using the fixed bed combustion of biomass fuels for reduction of the amount of NO in combustion gases from diesel engines. 1000 ppm NO was added to the primary air during the combustion of coniferous and birchwood chips, soft wood blocks and bark/wood chips pellets. The reduction of the amount of NO varied between 65 and 98 percent for a bed region stoichiometry of 0.45-0.72 and between 31 and 65 percent for a bed region stoichiometry of 1.41-1.51. According to the thermochemical calculations the reduction could be complete at bed region stoichiometries below 1.00, if the reaction time is allowed to be long enough. The formation of NO during the combustion of biomass fuel reach thermochemical equilibrium if the combustion temperature is enough. During the combustion of bark/wood chips pellets the combustion temperature was 1100-1200 deg C, which is high

enough for the equilibrium to be reached, while when the temperature is between 1000-1100 deg C, as during the combustion of straw pellets, the reaction goes to slow for the equilibrium to be attained. The computer code FLUENT has mainly been used for fluid dynamic calculations, but can also be used for simple kinetic modelling. The calculations give a good picture of the distribution of temperature, velocity and gas components over the cross section of the laboratory fixed bed furnace. 8 refs., 9 figs., 4 tabs.

5252 (SVF–440) **Reed canary grass tried as a fuel in commercial district heating plants in Denmark.** Burvall, J. (Sveriges Lantbruksuniversitet, Enheten foer Biomassa, Biobraenslen och Fibergroedor, Umeaa (Sweden)). Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden). Mar 1992. 67p. (In Swedish). Order Number DE93753064. Source: OSTI; NTIS.

In two different types of district heating combustion plants in Denmark, normally using straw as fuel, the energy grass Reed canary grass (summer harvested) has been tested as a new fuel. The combustion plant in Ringsted burns the fuel as whole bales with the so called 'cigar method'. In Nykoebing the fuel is burned on a rust as unpacked bales using a straw divider to divide the bales. The heating effect of the combustion plants is 4.5 MW and 4.0 MW, respectively. For both plants, there was no handling or technical problem observed in the test with Reed canary grass compared to straw. The analysis of the emission to air shows high average values for CO- and NO_x during the test period which is unacceptable according to Swedish limit values for emissions. For combustion plants with a heating effect over 10 MW, the limit values for NO_x is 100-200 mg/MJ. For smaller plants there are no limits values today but in the future demands for limitation of NO_x emission may come. For both plants, the O_2-content in fumes varied a lot, with a high mean value, about 10%. The content of chlorine in straw and energy grass can reach high levels. Most of the chlorine binds up in the ash (KCl), and therefore the emission of HCl are low. The emission to air of SO_x, which is 100 mg/MJ, is below the limit value for smaller plants. The variation of moisture and the low density are the properties of grass and straw that mainly causes problems in the combustion and gives high emission levels. Today it seems to be necessary to press the material into fuel briquetts or fuel pellets to get a better combustion, that can meet environmental demands. (7 figs., 17 tabs.).

0930 Economic, Industrial, and Business Aspects

5253 (NEI-DK–1032) **The operating economy of communal biogas plants by mid-1992.** Hjort-Gregersen, K. Statens Jordbrugsoekonomiske Inst., Valby (Denmark). 1992. 79p. (In Danish). Order Number DE93752976. Source: OSTI; NTIS; INIS.

The aim was to describe the status of the operational economy of Danish communal biogas systems one year after the Coordinating Committee for Communal Biogas Systems (Koordineringsudvalget for Biogasfaellesanlaeg) had published its main report. Initiatives aimed at the improvement of the systems' economy are also described. The economic analysis is based on actual current earnings. Tables also compare actual and expected earnings in the case of nine communal systems. It is concluded that methane production is generally high and stable as a result of adding organic wastes to the animal manures, yet maintenance and running costs are too high, and capital gains must be raised in order to achieve economical balance. It is recommended that prices and supply of organic wastes be regulated. The quality of used manures must be improved, also by reducing the moisture content. Process control must be initiated as a means of further increasing methane production. Transport systems should be analyzed in an attempt to reduce maintenance costs and the technology should be developed to obtain a stable operation. More personnel are required to ensure operational reliability. The overall administration should be stream-lined, and personnel training should be given higher priority - also implemented by means of manuals and servicing programmes. Personnel should be more familiar with aspects of the general related economy and cost control. (AB).

0940 Transport, Handling, and Storage

5254 (NEI-DK–1029) **Storage, transport and firing of sliced straw: Preliminary project.** Astrupgaard, N.P.; Nielsen, C.; Westborg, S. DK-Teknik, Soeborg (Denmark). Oct 1992. 94p. (In Danish). Contract ENS-51161-92.0009. Order Number DE93752979. Source: OSTI; NTIS.

An investigation of the management of sliced straw, used as fuel. Transport systems for getting the straw from the piles in the field to the plant, including commercial transport to the "pellet factory", are discussed. A vehicle for conveying wood chips (90 m^3), containers, and loading on stationary compactors, were also tested. It appears that here the costs can be compared with the transport of hesston bales. Problems arising when the sliced straw arrives at the plant are discussed, and recommendations on how to solve them are given. It is explained how to handle straw with a 30% water content. Experience was gained as to how existing wood-chip fuelled plants could be converted to straw combustion. It is concluded that costs could be significantly reduced in relation to the handling of sliced straw, also in relation to its transportation. (AB).

5255 (NUTEK-TB–92-8) **Long term storage of mixed bark-shavings fuel.** Jirjis, R. (Swedish Univ. of Agricultural Sciences, Uppsala (Sweden)); Lehtikangas, P. Swedish National Board for Industrial and Technical Development (NUTEK), Stockholm (Sweden); Swedish Univ. of Agricultural Sciences, Uppsala (Sweden). Dept. of Forest Products. 1992. 50p. (In Swedish). Project NUTEK-146-337. (SLU-VKL-R–230). Order Number DE93753078. Source: OSTI; NTIS.

Goal of this study was to examine consequences of storing bark mixed with dry shavings for 1 and 6 months. The pile comprised three sections: 40% spruce bark/60% shavings, 50% bark/50% shavings, and 100% bark. Each section contained 500 m^3 fuel. Two profiles were marked with 7 sampling points/profile. Initial bark moisture content was 46.3% while shavings contained 11.2% moisture. After one month of storage all sections showed reduced moisture content. This decline continued in the sections with mixed material while bark section showed an increased value. At the end of the storage period, moisture content had declined by 10%. Bark moisture content was still below the initial moisture content. Due to microbial activity, fuel temperature rose to over 50 C within a few days. Number of microfungal spores initially was high (max $2x10^{10}$ and $3x10^9$ spores/kg d.wt. after one month). By the end of 6 months, total spore count averaged between 0.7-0.8$x10^{10}$ spores/kg d.wt. O_2-concentration fell from 21% to 1-15% depending on the location of the measuring point. Simultaneously CO_2 levels increased from 0.03% up to 2-19%. After one month of storage, dry matter loss was highest in the section with 40% bark (5%). By the end of the storage period, the sections with mixed fuel showed 8% loss and in bark losses reached 9.3%. Initial gross calorific value was similar in all sections (about 20.7 MJ/kg d.wt.) This value was marginally reduced during storage. Net calorific value became slightly higher in mixed material because of drying. These results indicate that mixtures of bark could be stored outdoors in 7 m high piles, for the period May-November with relatively small risks for spontaneous combustion, minimal health hazard and producing a fuel with acceptable quality. However, under different conditions storage results could be different. (13 refs., 10 tabs., 14 figs.).

0950 Environmental Aspects

Refer also to citation(s) 6782

0980 Waste Management

Refer also to citation(s) 5251

10 SYNTHETIC FUELS

Refer also to citation(s) 4971

1002 Production

Refer also to citation(s) 5014, 5015, 5296

5256 (UCRL–53943-91, pp. 117-119) **Theoretical description of biomimetic complexes.** Winter, N.W.; Droege, M.W. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

In support of the development of new types of inorganic catalysts for converting methane to liquid fuels, the authors are investigating computational models to study intermediate reaction complexes that occur during the selective partial oxidation of methane. The authors have carried out first-principles calculations of the electronic structure at the active transition-metal sites in the catalysts to understand the relationship between structure, functionality, and catalytic activity and to guide the development of new materials.

5257 (UCRL–53943-91, pp. 120-123) **Subunit resolution for active site identification of Methylosinus trichosporium OB3b soluble methane monooxygenase.** Himmelsbach, M.M.; Taylor, R.T.; Droege, M.W. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

The authors have developed a procedure for the dissociation and resolution of the three distinct subunits of the soluble methane monooxygenase protein A. Using the net charge differences between the subunits to effect a separation by ion exchange chromatography, the individual subunits are isolated under denaturing conditions.

1003 Properties and Composition

Refer also to citation(s) 6141

1007 Economic, Industrial, and Business Aspects

Refer also to citation(s) 5900

13 HYDRO ENERGY

1301 Resources and Availability

5258 (TKK-S/SM–1989/21, pp. 43-53) **Baleriaux probabilistic production costing: The medium term pumping reservoir utilisation problem.** Conejo, A. (The Royal Institute of Technology, Stockholm (Sweden). Dept. of Electrical Machines and Power Electronics). Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Electromechanics. 1989. (CONF-8901144–: Symposium on electrical power engineering at the Helsinki University of Technology, Espoo (Finland), 27 Jan 1989). In *Symposium on electrical power engineering.* 130p. Order Number DE93711132. Source: OSTI; NTIS.

This paper presents a new, efficient and accurate algorithm for modelling optimal storage reservoir utilisation of pumping units in planning type probabilistic production costing models with multiple storage, thermal and limited energy units. This algorithm exploits, in a efficient way, the special nature of the production cost function which is piecewise linear with respect to the reservoir utilisation levels. The proposed algorithm is a significantly more efficient implementation of the building blocks of two former developments which are also presented.

5259 (VTT-SYMP–129) **Finnish-French symposium on water supply and sewerage.** Saarikoski, K. (ed.) (Technical Research Centre of Finland, Espoo (Finland). Road, Traffic and Geotechnical Lab.). Technical Research Centre of Finland, Espoo (Finland). 1992. 148p. (CONF-9109454–: Symposium on Finnish-French symposium on water supply and sewerage, Helsinki (Finland), 25-27 Sep 1991). Order Number DE93752846. Source: OSTI; NTIS.

This publication contains the proceedings of the Finnish-French symposium on water supply and sewerage, held in Helsinki, Finland, on 25-27 September, 1991. The motives to organise this symposium were to enhance the understanding of the state of water supply in both countries, the change of information, and to lay a good foundation for future cooperation in the field of water supply and sewerage. The Finnish papers form a complete State-of-the-Art Report of the Finnish water supply whereas the French presentations deal more with special topics on the diverse fields of water supply.

1303 Plant Design and Operation

5260 (ETDE-IT–92-100) **Hydraulic transient in power plant water supply systems: Theoretical and experimental simulation.** Di Filippo, A.; Molinaro, P.; Rossi, U. Ente Nazionale per l'Energia Elettrica, Milan (Italy). Centro di Ricerca Idraulica e Strutturale; Ente Nazionale per l'Energia Elettrica, Rome (Italy). 1991. 15p. (In Italian). (CONF-9105304–2: Giornate di studio per la celebrazione del centenario della nascita di G. Ippolito, Naples (Italy), May 1991). Order Number DE93748440. Source: OSTI; NTIS (US Sales Only); INIS.

The simulation, by means of numerical models, of hydraulic transients occurring in the supply of water to hydroelectric or thermal power plants has now become an essential task in the verification of future plant designs, as well as, in the planning of modifications to existing plants. This paper presents the RECAS hydraulic transients simulation code which was developed by ENEL (Italian Electricity Board), to meet the needs of designers of power plant hydraulic systems. This flexible code is able to handle variations in channel geometry and hydraulic network topology, as well as, different types of intake structures. The algorithm incorporated in the code is able to deal with open or closed sections, and allows the study of short high-velocity sections. The code's validity was confirmed in several applications.

5261 (NEI-NO–301) **A three-dimensional numerical model for simulation of sediment movements in water intakes.** Olsen, N.R.B. Trondheim Univ. (Norway). Norges Tekniske Hoegskole. Sep 1991. 106p. Order Number DE93752998. Source: OSTI; NTIS.

A numerical model for simulating sediment flow in a general three-dimensional geometry is described. The geometry can for example be a part of a river or an intake reservoir. The theoretical basis for the model is a combination of computational fluid dynamics with classic hydraulics and sediment transport theory. The model includes calculations of trap efficiency and deposition/erosion patterns. The model consists of several sub-programs, which include initialization and generation of a non-orthogonal three-dimensional grid which is fitted to the bed of the geometry. The sediment movement is calculated in other routines which solve the convection-diffusion equation for the sediments. Graphics routines are also included. To simulate the sediment concentration in the geometry it was necessary to know the water velocities in all three directions and the turbulent eddy viscosity. This was accomplished by using a numerical model called Spider to solve the Navier-Stokes equations with the k-ϵ turbulence model. Spider is a general flow model, and in adapting it to a river environment it was necessary to incorporate specific boundary conditions. This included symmetry conditions for the free surface, procedures for simulating a rough bed and estimation of parameters for inflowing variables. Spider was also modified so that it was possible to block out a region of the geometry. This modification made it possible to simulate flow around a bridge pier or a divide wall. The model was tested on various data sets. One was obtained from a laboratory experiment where sand was inserted into a flume and deposition was recorded. For more complex flows, erosion around a cylinder was simulated. 60 refs., 92 figs., 2 tabs.

1305 Economic, Industrial and Business Aspects

Refer also to citation(s) 5337

5262 (CONF-9101154–, pp. 113-123) **Hydroelectricity in Bavaria.** Haas, H. (Innwerk AG, Toeging/Inn (Germany)). Bayerisches Staatsministerium fuer Wirtschaft und Verkehr, Muenchen (Germany). 1991. 306p. (In German). From Symposium on incentives for using renewable energy sources in Bavaria; Coburg (Germany); 28-29 Jan 1991. In *Incentives for using renewable energy sources in Bavaria. Symposium for users and suppliers (local authorities, public utilities, industry, medium enterprises).* Order Number DE93744689. Source: OSTI; NTIS (US Sales Only).

Hydroelectric power with its share of 73.3% ranks first among renewable energy sources used for power generation in germany. This is about 1.3% of primary energy consumption. 59% of hydroelectric power is generated in Bavaria. A study indicates currently that another 13 hydroelectric power stations are worthy of extension; in addition, shut-down smallsized water power plants with an output of less than 1 MW and the retrofitting of available plants may be used to boost annual power output to c. 120 million kWh. (BWI).

5263 (DOE/EA–0811) **Proposed revision of the Cumberland System Power Marketing Policy and subsequent contracts.** USDOE Southeastern Power Administration, Elberton, GA (United States). [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93002204. Source: OSTI; NTIS; INIS; GPO Dep.

Southeastern Power Administration has prepared an Environmental Assessment (DOE/EA-0811) evaluating the proposed revision of the Cumberland System Power Marketing Policy and Subsequent Contracts. The findings of the Environmental Assessment (EA) are: the only significant change from the existing policy will be the term of the contracts executed under the revised policy; and there will be no addition of major new generation resources; there will be no new loads; there will be no major changes in the operating parameters of power generation resources. This paper discusses the need for action, the alternative and the environmental impacts.

1306 Environmental Aspects

Refer also to citation(s) 5263, 6561

5264 (DOE/EA–0749) **Swift Creek Hydroelectric Project rehabilitation, Swift Creek Power Company, Inc.: Final Environmental Assessment.** Forest Service, WY (United States). Bridger-Teton National Forest. Oct 1992. 118p. Sponsored by USDOE, Washington, DC (United States). (DOE/BP–1994). Order Number DE93003113. Source: OSTI; NTIS; INIS; GPO Dep.

The purpose of this report is to re-evaluate and update the original environmental analysis of the Swift Crook Hydroelectric Project rehabilitation. That analysis and the decision to allow the proponent toproceed with the project as described in the EA alternatives 3, 4, and 5 was completed an May 8, 1981. Since that decision, no action has been taken and no special-use permit has ever been issued. The Bridger-Trton National Forest completed a Forest Plan in March of 1990 which sets current direction for all lands within the Forest and new and significant issues pertaining to the amount of water to be bypassed have been raised by the public in response to this proposed project. The original proponent, Lower Valley Power and Light, sold the project and existing facilities to Swift Crack Power Company Inc. in 1984. Swift Crock Power Company has submitted a proposal to rehabilitate the existing power generation facility in Swift Creek Canyon, which will involve some significant construction and alteration of the river corridor. Theyhave also submitted an application for relicense to the Federal Energy Regulatory Commission who has asked for the Forest Service to comment on the application and to submit recommended conditions for approval (4e requirements). The proposed rehabilitation of existing facilities includes replacement of the existing damaged penstock (pipe) with a new, larger one; dredging two existing reservoirs and removal, refurbishment, and reinstallation of the turbines and generators in the two powerhouses with relocation and reconstruction of the lower powerhouse that is located on privately owned land below the Forest boundary.

5265 (DOE/EA–0788) **Sacramento Operations Center final environmental assessment.** Department of Energy, Sacramento, CA (United States). Western Area Power Administration. Aug 1992. 100p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93000408. Source: OSTI; NTIS; GPO Dep.

The Western Area Power Administration (Western) proposes to construct a new operations center in the metropolitan Sacramento area to eliminate overcrowding present in existing facilities and to improve efficiency. Alternatives considered for meeting the stated need include three different sites in the Sacramento metropolitan area, as well as no action. The three proposed sites have been evaluated based on four general categories: environmental impacts, economics, location, and operational efficiency. The proposed construction would consist of a building, adjacent parking lot, communications facilities. Field surveys conducted on the proposed sites include: a geotechnical survey, a cultural resources surveys and a biological assessment. These surveys revealed no unmitigable adverse impacts.

5266 (DOE/EIA–0169) **Yakima River Basin Fisheries Project: Draft Environmental Impact Statement.** USDOE Bonneville Power Administration, Portland, OR (United States). Oct 1992. 231p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93003074. Source: OSTI; NTIS; GPO Dep.

BPA proposed to fund several fishery related activities in the Yakima River Basin. These activities, known as the Yakima Fisheries Project (YFP), would be managed as a partnership among BPA, the State of Washington, and the Yakima Indian Nation. The YFP is a central feature of the Northwest Power Planning Council's (Council) fish and wildlife program. The Council selected the Yakima River system for attention because fisheries resources are severely reduced from historical levels and because there is a significant potential for enhancement of these resources. BPA's proposed action is: To fund the construction, operation, and maintenance of experimental facilities for anadromous fish; to develop and carry out research activities; and to gather information on supplementation techniques. Supplementation is a strategy for rebuilding fish spawning runs by releasing artificially propagated fish into natural streams to increase natural production. Alternatives for accomplishing the proposed action combine: Variations of stocks to enhance; numbers of salmon and steelhead to produce; and types and locations of facilities. The no-action alternative would leave present anadromous fisheries resources unchanged in the Yakima River Basin. The preferred alternative has not yet been selected. Major issues analyzed in the draft EIS include potential impacts of the project on genetic and ecological resources of existing fish populations. Only impacts from siting of the acclimation ponds and project operation are discussed; impacts from siting of other project facilities were discussed in a previously published Environmental Assessment. The YFP-is designed to operate with existing instream flow levels and project operations would not impact water rights in the Yakima River Basin. Environmental analysis included in this EIS will cover the operation of the planned production facilities and potential impacts from the siting and construction of acclimation facilities.

5267 (DOE/EIS–0141) **Final environmental impact statement, Washington Water Power/B.C. Hydro Transmission Interconnection Project.** USDOE Assistant Secretary for Fossil Energy, Washington, DC (United States). Office of Fuels Programs. Oct 1992. 794p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93003980. Source: OSTI; NTIS; INIS; GPO Dep.

Washington Water Power (WWP) proposes to construct and operate an electric transmission line that would connect with the electrical system of the British Columbia Hydro and Power Authority (B.C. Hydro). The project would be composed of a double-circuit, 230-kilovolt (kV) transmission line from WWP's existing Beacon Substation located northeast of Spokane, Washington to the international border located northwest of Metaline Falls, Washington. The original Presidential permit application and associated proposed route presented in the draft environmental impact statement (DEIS) have been modified to terminate at the Beacon Substation, instead of WWP's initially proposed termination point at the planned Marshall Substation located southwest of Spokane. A supplemental draft EIS was prepared and submitted for review to not only examine the new proposed 5.6 miles of route, but to also compare the new Proposed Route to the other alternatives previously analyzed in the DEIS. This final EIS (FEIS) assesses the environmental effects of the proposed transmission line through construction, operation, maintenance, and abandonment activities and addresses the impacts associated with the Proposed Action, Eastern Alternative, Western Alternative, Northern Crossover Alternative, Southern Crossover Alternative, and No Action Alternative. The FEIS also

contains the comments received and the responses to these comments submitted on the DEIS and Supplemental DEIS.

5268 (EDF-R–92-NI-V-0007) **Monitoring techniques for fish passes recently used in France.** Electricite de France (EDF), 92 - Clamart (France). Oct 1990. 11p. (In French). Source: OSTI; NTIS (US Sales Only).

A fish pass construction program has started some twelve years ago in France. Some of these passes have been monitored to test their efficiency, to acquire biological data on migratory fish and to perfect knowledge of fish passes design criteria. The paper presents the various techniques followed in these surveys: fish counting techniques, including conventional methods such as trapping or automatic resistivity fish counters and recently, more sophisticated techniques such as video recording and behavioral studies of fish by telemetry. Telemetric studies have been conducted on three migratory species: Atlantic salmon (Salmon salar), sea trout (salmo trutta trutta), allis shad (Alosa alosa). The advantages, drawbacks, field of application and cost of each techniques are discussed. (author). 16 refs., 7 figs., 1 tab.

14 SOLAR ENERGY

Refer also to citation(s) 5857

1405 Solar Energy Conversion

Refer also to citation(s) 5307

5269 (CONF-9101154–, pp. 33-54) **Solar cells and modules.** Hezel, R. (Erlangen-Nuernberg Univ., Inst. fuer Werkstoffwissenschaften (Germany)). Bayerisches Staatsministerium fuer Wirtschaft und Verkehr, Muenchen (Germany). 1991. 306p. (In German). From Symposium on incentives for using renewable energy sources in Bavaria; Coburg (Germany); 28-29 Jan 1991. In *Incentives for using renewable energy sources in Bavaria. Symposium for users and suppliers (local authorities, public utilities, industry, medium enterprises).* Order Number DE93744689. Source: OSTI; NTIS (US Sales Only).

Direct conversion of sun light to electric power by means of photovoltaic solar cells has attracted increasing interest in this antipollution, inexhausitible energy source in recent years. The author discusses today's state of the art and development trends in the field of terrestrial solar cells and modules with special reference to activities undertaken in Bavaria. (orig./BWI).

5270 (ETDE-mf–93744915, pp. 3-5) **Status of photovoltaics in Germany. Thin layer solar cells.** Stahl, D. Bundesverband Solarenergie e.V. (BSE), Essen (Germany). Jun 1992. 31p. In *Decentralized electricity production with photovoltaic power systems.* Order Number DE93744915. Source: OSTI; NTIS (US Sales Only).

Short communication. PHOTOVOLTAIC CONVERSION/federal republic of germany; PHOTOVOLTAIC CONVERSION/forecasting; FORECASTING; SOLAR CELLS; THIN FILMS

5271 (ETDE-mf–93744915, pp. 6-7) **Status of photovoltaic technology. Crystalline silicon solar cells.** Hoffmann, W. Bundesverband Solarenergie e.V. (BSE), Essen (Germany). Jun 1992. 31p. In *Decentralized electricity production with photovoltaic power systems.* Order Number DE93744915. Source: OSTI; NTIS (US Sales Only).

Short communication. SILICON SOLAR CELLS/design; SILICON SOLAR CELLS/crystal structure; PHOTOVOLTAIC CONVERSION; DESIGN; FORECASTING; MANUFACTURING

5272 (NREL/CP–413-5064) **Second workshop role of point defects/defect complexes in silicon device fabrication: Book of abstracts.** National Renewable Energy Lab., Golden, CO (United States). [1992]. 59p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. (CONF-9208175–Absts.: 2. workshop on role of point defects/defect complexes in silicon device fabrication, Breckenridge, CO (United States), 24-26 Aug 1992). Order Number DE92016424. Source: OSTI; NTIS; GPO Dep.

Abstracts are presented of 24 papers, arranged under the following session/panel headings: defects and impurities in commercial photovoltaic Si substrates, point defects and point defect processes, impurity gettering for Si solar cells, gettering in Si solar cells, and passivation of impurities and defects.

5273 (NREL/TP–411-5125) **Measurement uncertainty analysis techniques applied to PV performance measurements.** Wells, C. National Renewable Energy Lab., Golden, CO (United States). Oct 1992. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. (CONF-9209252–1: Photovoltaics performance and reliability workshop, Golden, CO (United States), 16-18 Sep 1992). Order Number DE93000019. Source: OSTI; NTIS; INIS; GPO Dep.

The purpose of this presentation is to provide a brief introduction to measurement uncertainty analysis, outline how it is done, and illustrate uncertainty analysis with examples drawn from the PV field, with particular emphasis toward its use in PV performance measurements. The uncertainty information we know and state concerning a PV performance measurement or a module test result determines, to a significant extent, the value and quality of that result. What is measurement uncertainty analysis? It is an outgrowth of what has commonly been called error analysis. But uncertainty analysis, a more recent development, gives greater insight into measurement processes and tests, experiments, or calibration results. Uncertainty analysis gives us an estimate of the I interval about a measured value or an experiment's final result within which we believe the true value of that quantity will lie. Why should we take the time to perform an uncertainty analysis? A rigorous measurement uncertainty analysis: Increases the credibility and value of research results; allows comparisons of results from different labs; helps improve experiment design and identifies where changes are needed to achieve stated objectives (through use of the pre-test analysis); plays a significant role in validating measurements and experimental results, and in demonstrating (through the post-test analysis) that valid data have been acquired; reduces the risk of making erroneous decisions; demonstrates quality assurance and quality control measures have been accomplished; define Valid Data as data having known and documented paths of: Origin, including theory; measurements; traceability to measurement standards; computations; uncertainty analysis of results.

5274 (SAND–92-0658C) **Low-temperature emitter-passivation for silicon solar cells.** Ruby, D.S. (Sandia National Labs., Albuquerque, NM (United States)); Levine, J.D. Sandia National Labs., Albuquerque, NM (United States). [1992]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-921229–1: 11. European photovoltaic solar energy conference, Montreaux (Switzerland), 16 Dec 1992). Order Number DE93002483. Source: OSTI; NTIS; GPO Dep.

We have developed a process that provides much of the performance improvement possible from a high-quality emitter passivation while maintaining cell temperatures at or below 400°C. Using atmospheric-pressure chemical-vapor deposition (CVD) Of SiO_2 at 400°C followed by a 400°C forming gas anneal, we have been able to produce a 3.1-fold increase in the blue response of cells compared to that of unpassivated cells. This has resulted in up to an 11% increase in AM1.5G short-circuit current due to the passivating qualities of the CVD oxide. This technique represents a low-cost approach to boost the performance of cells that do not presently employ passivating oxides. It would be of particular value to any silicon cell process in which material or other constraints preclude the use of a high-temperature thermal oxidation for the purpose of emitter passivation. This also applies to cells using material whose bulk lifetime is reduced by multiple high-temperature thermal excursions.

5275 (SAND–92-1825C) **Spin dependent photocurrents in ribbon solar cells.** Seager, C.H.; Venturini, E.L.; Schubert, W.K. Sandia National Labs., Albuquerque, NM (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9208175–1: 2. workshop on role of point defects/defect complexes in silicon device fabrication, Breckenridge, CO (United States), 24-26 Aug 1992). Order Number DE93002486. Source: OSTI; NTIS; GPO Dep.

Spin Dependent Transport (SDT) is a method of identifying recombination centers which employs a microwave resonance condition to affect the recombination rate of minority carriers in a device. When this technique is used to analyze the diffusion-limited currents produced by long-wavelength optical excitation, it has the potential to chemically identify the major recombination sites in solar cells. We have used this resonance technique to analyze short circuit photocurrents in Edge-defined film-Fed Growth (EFG) ribbon silicon solar cells. At room temperature, our observed photocurrent resonances have zero-crossing g values and linewidths which are similar to SDT observations made on the trans-barrier currents in silicon bicrystals, and electron spin resonance signals seen in damaged silicon, and polycrystalline silicon. These dangling-bond-like SDT signals depend on cell illumination levels in a way that suggests that the values of recombination velocity at electrically active linear boundaries decrease with illumination intensity. Hydrogen processed cells show markedly smaller SDT response, consistent with the passivation of Si dangling bond defects. While most of our SDT observations have been made on n⁺/p EFG cells, we suggest that measurements made at low temperatures on other cell structures might uncover resonances due to other recombination centers in this material.

1406 Photovoltaic Power Systems

Refer also to citation(s) 5754, 5774, 5793

5276 (CONF-9101154–, pp. 55-73) **Photovoltaic power supply systems.** Wagner, U. (Forschungsstelle fuer Energiewirtschaft, Muenchen (Germany)). Bayerisches Staatsministerium fuer Wirtschaft und Verkehr, Muenchen (Germany). 1991. 306p. (In German). From Symposium on incentives for using renewable energy sources in Bavaria; Coburg (Germany); 28-29 Jan 1991. In *Incentives for using renewable energy sources in Bavaria. Symposium for users and suppliers (local authorities, public utilities, industry, medium enterprises).* Order Number DE93744689. Source: OSTI; NTIS (US Sales Only).

The development of photovoltaic systems is known to have reached a high level in Germany. Development focusses not only on advanced single components but also on system technology to control technical processes. Optimized matching and dimensioning taking into account the pertinent marginal conditions are additional focal points. These criteria may greatly determine the energy and economic profitabilities of PV systems. The author discusses some of these aspects. (orig./BWI).

5277 (CONF-9101154–, pp. 127-138) **The solar-hydrogen project at Neunburg vorm Wald.** Fuchs, M. (Bayernwerk AG, Muenchen (Germany)); Eingartner, M. Bayerisches Staatsministerium fuer Wirtschaft und Verkehr, Muenchen (Germany). 1991. 306p. (In German). From Symposium on incentives for using renewable energy sources in Bavaria; Coburg (Germany); 28-29 Jan 1991. In *Incentives for using renewable energy sources in Bavaria. Symposium for users and suppliers (local authorities, public utilities, industry, medium enterprises).* Order Number DE93744689. Source: OSTI; NTIS (US Sales Only).

Currently, a project is being implemented which may be expected to meet the ideals of a future energy economy in terms of environmental impacts: an energysystem based on solar energy and hydrogen. The solar- hydrogen cycle is based on photovoltaic generation of electric power which can be stored by means of electrolytic cracking of water. The authors report on the state of this project. A second phase ranging from 1992 to 1996 is directed at doubling the solar cell field which uses 3rd generation solar cells (semiconductors made from amorphous silicon). (BWI).

5278 (CONF-9101154–, pp. 151-167) **Photovoltaics in Swabia - small-sized heat pumps in Swabia - heat pump district heating plant in Swabia.** Fischer, M. (Lech-Elektrizitaetswerke AG, Augsburg (Germany)). Bayerisches Staatsministerium fuer Wirtschaft und Verkehr, Muenchen (Germany). 1991. 306p. (In German). From Symposium on incentives for using renewable energy sources in Bavaria; Coburg (Germany); 28-29 Jan 1991. In *Incentives for using renewable energy sources in Bavaria. Symposium for users and suppliers (local authorities, public utilities, industry, medium enterprises).* Order Number DE93744689. Source: OSTI; NTIS (US Sales Only).

The author reports on three different plants to use renewable energy sources in Swabia: one photovoltaic system consisting in about 12 sqm of solar cells with a peak output of 1,100 W at a voltage of 70 V; small-sized heat pump systems for building heating; one heat-pump district heating plant to supply a new residential area of about 800 appartments/flats. The author describes their designs and functions. (BWI).

5279 (ETDE-mf–93744915) **Decentralized electricity production with photovoltaic power systems.** Bundesverband Solarenergie e.V. (BSE), Essen (Germany). Jun 1992 31p. Order Number DE93744915. Source: OSTI; NTIS (US Sales Only).

In this report seven papers discuss the state of the art of photovoltaic technology. Themes: Status of photovoltaics in Germany; Storage technology for photovoltaic energy generation; Photovoltaic technologies for hybrid systems; Water supply and treatment with photovoltaic systems; Photovoltaics for telecommunications; Photovoltaic systems integrated into Buildings. For all seven papers a separate subject analysis has been carried out. (BWI).

5280 (ETDE-mf–93744915, pp. 8-12) **Storage technology for photovoltaic energy generation.** Paschakarnis, P. Bundesverband Solarenergie e.V. (BSE), Essen (Germany). Jun 1992. 31p. In *Decentralized electricity production with photovoltaic power systems.* Order Number DE93744915. Source: OSTI; NTIS (US Sales Only).

The use and efficiency of photovoltaics depends on electric power storage technology. Electrochemical energy stores (electric batteries) are availabe for this purpose. Tested systems here include lead/acid an nickel/cadmium batteries. In the paper the selection criteria and battery systems for special applications are discussed. (BWI).

5281 (ETDE-mf–93744915, pp. 13-17) **Photovoltaic technologies for hybrid systems.** Cordes, V. Bundesverband Solarenergie e.V. (BSE), Essen (Germany). Jun 1992. 31p. In *Decentralized electricity production with photovoltaic power systems.* Order Number DE93744915. Source: OSTI; NTIS (US Sales Only).

Photovoltaic systems certainly have the largest potential application worldwide. Nevertheless, the energy provided by the sun does not always fit the load profile of the consumer. To ensure a reliable supply with applications in stand-alone operation, storage batteries are frequently installed to make the adaptation. In the future, economical solutions can also be provided by network-coupled photovoltaic systems without storage, as well as by hybrid systems in which several renewable energy sources produce a well-adapted supply of energy. These concepts can also be complemented by energy management and load management subsystems which permit optimum adaptation by the consumer to the energy supply without a loss of comfort. As examples, various systems installed in Germany will be presented. (orig./BWI).

5282 (ETDE-mf–93744915, pp. 18-21) **Water supply and treatment with photovoltaic systems.** Goethe, R. Bundesverband Solarenergie e.V. (BSE), Essen (Germany). Jun 1992. 31p. In *Decentralized electricity production with photovoltaic power systems.* Order Number DE93744915. Source: OSTI; NTIS (US Sales Only).

The paper describes the areas of solar energy application by photovoltaic power systems in the field of water supply and treatment. In detail they are: Water raising (drinking water, trough water for cattle, field irrigation, dewatering and drainage pumps), water purification (filtration, sterilisation, desalination through reverse osmosis), water conditioning (chlorination, aeration) and water recirculation (recirculation pumps, fountain pumps). Examples for most of the applications are given. (BWI).

5283 (ETDE-mf–93744915, pp. 22-25) **Photovoltaics for telecommunications.** Stahl, D. Bundesverband Solarenergie e.V. (BSE), Essen (Germany). Jun 1992. 31p. In *Decentralized electricity production with photovoltaic power systems.* Order Number DE93744915. Source: OSTI; NTIS (US Sales Only).

Photovoltaic energy supplies have been considered for many years as a reliable and economically worthwhile solution for the decentralized power supply of telecommunication facilities over a wide

power range and in the most varied climatic zones. All of the programs, components and systems required for the safe design and the reliable operation are available from the German photovoltaic industry. The paper presents some applications of photovoltaic power supplies in the field of telecommunications. (BWI).

5284 (ETDE-mf–93744915, pp. 26-31) **Photovoltaic systems integrated into buildings.** Hopf, P. Bundesverband Solarenergie e.V. (BSE), Essen (Germany). Jun 1992. 31p. In *Decentralized electricity production with photovoltaic power systems*. Order Number DE93744915. Source: OSTI; NTIS (US Sales Only).

While solar thermal collectors using the heat of the suns's radiation especially to prepare hot water have already made wide entrance into the energy recovery concepts of modern buildings, the innovative photovoltaic modules for direct power generation from sunlight are only now in the trial phase of building integration. These most recent achievements of the energy recovery technology in the form of photovoltaic systems will now be demonstrated of the basis of some examples of projects already installed in Germany. The projects have been implemented with modules made of crystalline cells. (BWI).

5285 (LEM–92-04) **High-efficient line converter in 'Hybrid-Concept'.** Meyer, M. Eidgenoessische Technische Hochschule, Zurich (Switzerland). Chair of Power Electronics and Electrometrology. Oct 1992. 40p. (In German). EC/PROC(91)43. Order Number DE93743642. Source: OSTI; NTIS.

Large voltage source inverters (VSI) with GTO-Thyristors produce high losses during the switching processes. Therefore, their switching frequency is strictly limited to a few hundred Hertz. A high level of harmonic content in the load current is the result. When VSIs serve as line converters for the exchange of active or reactive power between the AC mains and a DC link, these high harmonic currents can not be tolerated in the mains. In the present report, the parallel connection of a high power VSI with GTO-thyristors and a low power VSI which works as an active filter is investigated. As an option, the active filter is able to transmit active power when the main inverter is turned off. This feature is advantageous for all applications where part-load conditions occur frequently and leads to the name 'hybrid concept'. The main dimensioning rules, such as power rating, switching frequency and stray reactance of the transformers, are presented for both inverters. The optimization of the different parameters is based on a detailed analysis of the losses, especially those of the main inverter. The results show that the combination of a large VSI with an active filter does not only improve the line current spectrum and the behaviour in case of a distorted line voltage, but can also lead to reduced losses. Two applications, a large solar power station and an inverter locomotive, are considered in detail. (author) figs., tabs., 19 refs.

1407 Solar Thermal Power Systems

Refer also to citation(s) 5306

5286 (ETDE-mf–93750639) **System comparison and potential of solar thermal power plants in the Mediterranean (Phase 1). Short version.** Klaiss, H.; Staiss, F.; Nitsch, J.; Hiller, J.; Sigler, M.; Steinborn, F.; Hille, G.; Kern, J.; Meyer, J.; Kiera, M.; Wehowsky, P.; Schiel, W.; Schweitzer, A. Deutsche Forschungsanstalt fuer Luft- und Raumfahrt e.V. (DLR), Stuttgart (Germany). Studiengruppe Energiesysteme; Internationale Atomreaktorbau GmbH (INTERATOM), Bergisch Gladbach (Germany); Schlaich Bergermann und Partner, Stuttgart (Germany); Zentrum fuer Sonnenenergie- und Wasserstoff-Forschung (ZSW), Stuttgart (Germany). Oct 1991 38p. (In German). Order Number DE93750639. Source: OSTI; NTIS (US Sales Only).

Solar thermal power plants for electric power generation were investigated with a view to their marketing chances and future prospects in the Mediterranean. Representative systems were investigated, i.e. tower focus power plants and parabolic through collectors for grid connetion and solar dish/stirling systems for small-scale consumers and autonomous grids. The report summarizes the main results. (BWI).

5287 (ETDE-mf–93750643) **System comparison and potential of solar thermal power plants in the Mediterranean. Preliminary study. Main report.** Hille, G.; Klaiss, H.; Meyer, J.; Schiel, W.; Staiss, F.; Wehowsky, P.; Hiller, J. Deutsche Forschungsanstalt fuer Luft- und Raumfahrt e.V. (DLR), Stuttgart (Germany). Studiengruppe Energiesysteme; Internationale Atomreaktorbau GmbH (INTERATOM), Bergisch Gladbach (Germany); Schlaich Bergermann und Partner, Stuttgart (Germany); Zentrum fuer Sonnenenergie- und Wasserstoff-Forschung (ZSW), Stuttgart (Germany). Jul 1991 151p. (In German). Order Number DE93750643. Source: OSTI; NTIS (US Sales Only).

Whenever large power plant unit capacities are required, only hydroelectric power plants and solar thermal power plants are economically efficient. The investigation focused on tower focus power plants and parabolic through collector power plants for grid connection and solar dish/stirling system which are designed primarily for small-scale consumers and autonomous networks. The marketing protential is limited to regions between 40deg Northern and 40deg Southern latitude, especially the Mediterranean. (BWI).

5288 (SAND–92-2123C) **Development of CPG dish-Stirling systems for remote power applications.** Kubo, I. (Cummins Power Generation, Inc., Columbus, IN (United States)); Diver, R.B. Sandia National Labs., Albuquerque, NM (United States). [1992]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-920938–3: 6. international symposium on solar thermal concentrating technologies, Mojacar (Spain), 25 Sep - 2 oct 1992). Order Number DE93003251. Source: OSTI; NTIS; GPO Dep.

Through a program sponsored by the US Department of Energy (DOE), Cummins Power Generation, Inc. (CPG) and Sandia National Laboratories (SNL) have entered into a joint venture to develop and commercialize economically competitive dish-Stirling systems for remote power applications. Sixteen systems, representing three generations of technology, will be developed, fielded, and tested in the Dish-Stirling Joint Venture Program (JVP). The JVP is funded equally by a consortium led by CPG and by the DOE. After completion of the program, CPG's commercialization effort will continue with limited production expected to start in 1996. In this paper, the program plan and the technology used in the JVP are outlined. ne current status of the key system components, and the initial results of a system optimization study including current cost and performance estimates, are also provided.

1409 Solar Thermal Utilization

Refer also to citation(s) 4912, 5300, 5301, 5303, 5304, 5757, 5772, 5774, 5775, 5776, 5777, 5778, 5779, 5780, 5781, 5783, 5784, 5787, 5788, 5814, 5855

5289 (DOE/SF/16306–34) **Colorado State University program for developing, testing, evaluating and optimizing solar heating and cooling systems: Project status report, March–November 1992.** Colorado State Univ., Fort Collins, CO (United States). Solar Energy Applications Lab. 7 Jan 1993. 55p. Sponsored by USDOE, Washington, DC (United States); Colorado State Univ., Fort Collins, CO (United States); American Solar Network (United States); Sun Utility Network (United States). DOE Contract FG02-86SF16306. Order Number DE93005795. Source: OSTI; NTIS; GPO Dep.

This program includes six tasks, including (1) a project measuring the performance of unique solar system components, (2) a project to develop a methodology for determining annual performance ratings of solar domestic hot water systems, (3) a project that will identify, analyze, design, build, and experimentally evaluate SDHW systems incorporating advanced concepts and components, (4) a liquid desiccant cooling system development project, (5) a project that will perform TRNSYS simulations to determine potential energy savings for desiccant cooling systems, especially in humid climates, and (6) a management task. The objectives and progress in each task are described.

5290 (DTH-LV–91-13) **Solar ice-pack freezer and refrigerator.** Kofod, P. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Varmeisolering. May 1991. 30p. Order Number DE93752990. Source: OSTI; NTIS.

An innovative type of solar collector (parabolic trough collector), having the characteristics of which are a concentrating evacuated tube collector with very high efficiency at high performance temperatures, had been developed. The idea had been to develope a collector able to satisfy high energy demands at higher temperatures than those reached by using a flat plate collector of a more traditional design. This concentrating solar collector could potentially be used as an energy source for a refrigerator of the absorption type, and the refrigerator could serve as a storage facility for vaccine, where the temperature must be kept between 0 - 8 degrees centigrade. The report sums up the work currently being done in relation to the development of the solar-powered absorption refrigerator, the freight to India where it should be utilized and the monitoring work carried out in the Solar Energy Centre in New Delhi. (AB).

5291 (DTH-LV–91-17) **Solar walls: Status and plan for research, development and demonstration projects.** Svendsen, S. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Varmeisolering. Jun 1991. 49p. (In Danish). Order Number DE93752992. Source: OSTI; NTIS.

The aim was to contribute to the coordination of research and development activities relevant to solar walls by presenting a survey of Danish research activities within this area. The report comprises of print-outs of relevant Danish project descriptions taken from the Nordic Energy Index database and based on a search carried out at Risoe Library (at Risoe National Laboratory) which is responsible for the coordination of Nordic input to this database. Very brief comments are given on the availability or non-availability of various types of relevant information. (AB).

5292 (DTH-LV–230) **Small low flow solar heating systems: Experience from practice.** Furbo, S. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Varmeisolering. May 1992. 47p. Order Number DE93752749. Source: OSTI; NTIS.

Nine small low flow solar heating systems for domestic hot water supply have been built by three producers of solar collectors. The operation of the systems have been followed since the installation. The investigations showed that the promising results from laboratory experiments with small DHW low flow systems can be transferred to practice. Small DHW low flow systems can thus work without any problems with very high thermal performances. However, the investigations also showed that it is essential to optimize, design and install the systems in the right way. Only in this way the systems will be reliable and durable with high thermal performances. The design and control of the system should ensure that the heat loss from the heat storage is minimized and that the auxiliary energy source(s) only heat the needed volume of water to the required hot water temperature. Furthermore, thermosyphoning in the solar collector loop during nights and boiling in the solar collector during summer holidays should be avoided. Furthermore, in systems with a circulation piping it is important that the water returning from the circulation piping enters the hot water tank without causing mixing inside the tank. The low flow principle makes it possible both to increase the thermal performance and to decrease the costs of the solar heating systems. To day only one Danish manufacturer is producing low flow systems. The experience from this project can therefore be utilized in connection with the developing work of the other producers in such a way that inexpensive, reliable, durable marketed low flow systems with high thermal performances can be developed. (au) (11 refs.).

5293 (ETSU-S–1163/SBS/7) **Solar building study. Summary report: Spinney Gardens [Crystal Palace, London].** University of Wales Coll. of Cardiff (United Kingdom). Welsh School of Architecture. 1991. 10p. Order Number DE93756628. Source: OSTI; NTIS (US Sales Only).

Work performed under the Energy Performance Assessments (EPA) Project.

A summary report is given of the performance of a two-storey terraced house with passive solar heating features. Total annual fuel use of 10896 kWh compared very favourably with that of a well insulated double glazed design. Fuel used for space heating was 80 kWh/m^2/year. The energy performance was substantially influenced by solar gains. Without such gains gas use for space heating would have been 30% higher. The solar performance was not at the expense of occupant comfort, for there was little reported overheating, due to the adequate isolation of the conservatory from the living areas. Although very comfortable the building was most valued for its character, which was strongly influenced, both indoors and out, by the conservatory. At Pound 518/m^2 GFA (71m^2) (2nd 1/4 1989) Spinney Gardens, with a conservatory, was estimated to cost more than a comparable traditional house Pound 506/m^2 GFA (64m^2) without a conservatory. (author).

5294 (NEI-DK–993) **Solar walls in Vibekevang - energy retrofitting.** Bruun Joergensen, O. (Laboratoriet for Varmeisolering, DTH (Denmark)); Frydensberg, O. Kooperativ Byggeindustri A/S, Copenhagen (Denmark); Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Varmeisolering; Danoe's (L.) Tegnestue, Charlottenlund (Denmark). Jun 1992. 27p. (In Danish). Contract TR-89.0238. Order Number DE93752804. Source: OSTI; NTIS.

Vibekevang in Copenhagen, Denmark, is a collection of 96 architecturally attractive two-and-a-half storey buildings, in all 540 homes. The residents, stimulated by an active residents' association, are well integrated socially. This association took the initiative to instigate a "greener Vibekevang" and are interested in using renewable energy sources. Cooperation with the Laboratory for Thermal Insulation at the Technical University of Denmark resulted in the initiation of a project concerning the use of passive solar energy for space heating by covering some of the buildings' facades with glass. The solar wall consists of a solid non-insulated brickwork outer wall which is retrofitted to absorb and accumulate solar heat by using a covering of transparent insulation material and glass plate. An investigation of the architecture, building technology, energy savings and economy was carried out and is described in detail. The evaluation of the latter is based on measurements taken over a one-year period. Measurement methods and results are given. Residents were satisfied with the appearance of the walls. Rooms were not overheated except for a very short periods during heat waves. The solar walls were less damp than the original ones. Energy savings amounted to 936 kWh p.a. per flat, this could be optimized to 85% with little extra expence. A cost-benefit analysis shows that the payback period is long but are weighed up by the benefits. (AB) (10 refs.).

5295 (NEI-DK–1001) **Utilization of renewable energy in commercial greenhouses.** Yde, L. Nordvestjysk Folkecenter for Vedvarende Energi, Hurup (Denmark). Sep 1992. 36p. (In Danish). Contract TR-85.266. Order Number DE93752812. Source: OSTI; NTIS.

The concept of this "Plus Energy House" is a building which uses only solar energy for heating purposes and can be used both as a greenhouse (a winter garden) and as office premises at the same time. The design is based on mobile insulation, a bead wall, humidity control and recovery of solar heat with the help of heat pumps. The building incorporates an area of 590 m^2, and produces surplus energy on an annual basis of ca. 100,000 kWh, which is the amount that four detached houses use for heating annually. A 360 m^2 glass roof with a southerly orientation ensures solar heating of floor, walls and ceilings. The building is heated up within a few hours and, with the help of mobile insulation (polystyrene balls) in the glass roof no more solar energy is needed for two days. The roof is constructed of two layers of hardened glass filled with the polystyrene balls which are blown and sucked backwards and forwards and are used at night to keep in the heat and by day as a means of shading if the rooms become too hot. When the sun shines on the plants, water evaporates and rises to the ceiling were it hangs in the form of water drops on the rows of plastic tubes which hang there. These then drop into a channel and are lead away. The water in the tubes circulate to a heat pump which sends the heated water into the heating system and out of the building where it is sold in the form of district heating. Cold and heat storage facilities level the difference between production and need, thus the heat pumps need not be so large. The total area of plant leaves acts as a solar collector. Technical details and diagrams further illustrate this concept. (AB).

5296 (SAND–92-2189C) **Solar reforming applications study summary.** Spiewak, I. (Weizmann Inst. of Science, Rehovoth (Israel)); Tyner, C.; Langnickel, U. Sandia National Labs., Albuquerque, NM (United States). [1992]. 14p. Sponsored by USDOE,

Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-920938–5: 6. international symposium on solar thermal concentrating technologies, Mojacar (Spain), 25 Sep - 2 oct 1992). Order Number DE93002286. Source: OSTI; NTIS; GPO Dep.

Research in recent years has demonstrated the efficient use of solar thermal energy for driving endothermic chemical reforming reactions in which hydrocarbons are reacted to form syngas. Closed-loop reforming/methanation systems can be used for storage and transport of process heat and for short-term storage for peaking power generation. Open-loop reforming and gasification systems can be used for direct fuel production; for production of syngas feedstock for further processing to bulk ammonia, hydrogen, and liquid fuels; and for destruction of hazardous organic materials. To help identify the most promising areas for future development of this technology, we discuss in this paper the market potential of these applications.

5297 (TVA-Bull–Z-301) **Solar evaporation of fertilizers/agchemical aqueous mixtures.** Ash, D.H. (National Fertilizer and Environmental Research Center, Muscle Shoals, AL (United States)); Salladay, D.G.; Norwood, V.M.; Guinn, G.R. National Fertilizer and Environmental Research Center, Muscle Shoals, AL (United States); Alabama Solar Energy Center, Huntsville, AL (United States). [1991]. 20p. Sponsored by Tennessee Valley Authority, Knoxville, TN (United States). Order Number DE93002454. Source: OSTI; NTIS.

Even when best management practices are employed, dealers can have 2000 to 7000 gallons of fertilizer/pesticide rinsewaters each year that cannot be used on nonlabel crops or indiscriminately applied or disposed of without violating Environmental Protection Agency (EPA) pesticide label application regulations. A novel, easily implemented solution for reduction of these rinsewaters has been developed at the University of Alabama at Huntsville (UAH) working with researchers from the Tennessee Valley Authority's (TVA) National Fertilizer and Environmental Research Center (NFERC), Muscle Shoals, Alabama. Researchers have developed a passive flat-plate solar evaporator. It is a stainless steel/glass unit approximately 8inches x 7inches x 5inches, and can be produced on an assembly line basis for less than $4000 each. NFERC technologists will use these units for environmental research and demonstration projects at other universities and dealers this year. Each unit can evaporate 900–1200 gallons of water per year.

1410 Solar Collectors and Concentrators

Refer also to citation(s) 5288, 5734, 5775, 5784

5298 (CONF-9205279–, pp. 79-86) **Standardization in solar energy technology and engineering.** Schoelkopf, W. (Muenchen Univ. (Germany). Sektion Physik). Ostbayerisches Technologie-Transfer-Institut e.V. (OTTI), Regensburg (Germany). 1992. 304p. (In German). From 2. national symposium on thermal solar energy (TSE); Staffelstein (Germany); 14-15 May 1992. In *Second national symposium 'Thermal solar energy'.* Order Number DE93744460. Source: OSTI; NTIS (US Sales Only).

The profitability of solar systems greatly depends on their thermal performance. To rate it reliably, standardized measurement methods are needed for systems and components. These measurement methods shall give comparable results and shall allow to predict the performance for any operating conditions. The author reports on the current state of national and international standardization. In Germany, standards DIN 4757 and DIN 1988 are applicable. Internationally, there are the standards ISO 9059, ISO 9060, ISO 9090, ISO 9901, ISO 9846, ISO 9847, ISO 9845, ISO 9459/1-4, ISO 9806/1-3, ISO 9553. These standards are briefly demonstrated. (BWI).

5299 (CONF-9205279–, pp. 87-104) **Method to determine the performance of thermal solar collectors in out-door applications.** Frei, U. (Nationale Solarenergie-Pruef- und Forschungsstelle BEW/ITR, Interkantonales Technikum, Rapperswil (Switzerland)); Haeuselmann, T.; Weber, A.; Flueckiger, F.; Frey, R. Ostbayerisches Technologie-Transfer-Institut e.V. (OTTI), Regensburg (Germany). 1992. 304p. (In German). From 2. national symposium on thermal solar energy (TSE); Staffelstein (Germany); 14-15 May 1992. In *Second national symposium 'Thermal solar energy'.* Order Number DE93744460. Source: OSTI; NTIS (US Sales Only).

Selection of a suitable solar collector needs to be based on accurate knowledge of their performance and efficiency. The test method used needs to be as close to real conditions as possible, i.e. its results need to reflect the efficiency across the whole functional range of the test collector. This method will give an efficiency characteristic which meets this requirement. The most important aspect is that of testing out-of-doors in the field i.e. under conditions of natural irradiation, natural atmospheric counterradiation, etc. Test results will be input into a gross thermal yield model to assess the annual yields of different collector types. Accurate dimensioning of systems will not be feasible unless the yield of the collector concerned is known. (orig.).

5300 (CONF-9205279–, pp. 119-128) **Optimization of the total efficiency of solar domestic-water heating systems.** Herkel, S. (Fraunhofer-Inst. fuer Solare Energiesysteme, Freiburg im Breisgau (Germany)); Fischbach, H.P.; Wagner, A.; Asmussen, J. Ostbayerisches Technologie-Transfer-Institut e.V. (OTTI), Regensburg (Germany). 1992. 304p. (In German). From 2. national symposium on thermal solar energy (TSE); Staffelstein (Germany); 14-15 May 1992. In *Second national symposium 'Thermal solar energy'.* Order Number DE93744460. Source: OSTI; NTIS (US Sales Only).

A collector system was used to study the operating behaviour of a novel domestic-water heating tank, the "stratified tank". The collectors used were flat-plate collectors improved by transparent thermal insulation. In summer '91, measurements were performed on a system with an aperture surface area of 6.4 sqm, and in winter '91/'92, measurements were performed on a larger system (11.3 sqm) to determine solar energy coverage percentages at reduced irradiation. Systems were measured with the dynamic system test which involves short measurement sequences to determine the characteristic dynamic behaviour of the complete system. Building-up of a good tempeerature stratification in the tank on charging could be confirmed. Long-term predictions indicated an annual efficiency of 30% at a coverage of 79%. Measurements performed on a system with a larger collector area in winter, provided system efficiencies which ranged between 26% and 40% for the measurement sequences. Simulation calculations showed a fairly good agreement with measurement readings. (orig./BWI).

5301 (CONF-9205279–, pp. 129-139) **Further development of collectors to generate process heat in the temperature range up to 200 deg C.** Niemann, M. (Inst. fuer Solarenergieforschung (ISFH), Hannover (Germany)). Ostbayerisches Technologie-Transfer-Institut e.V. (OTTI), Regensburg (Germany). 1992. 304p. (In German). From 2. national symposium on thermal solar energy (TSE); Staffelstein (Germany); 14-15 May 1992. In *Second national symposium 'Thermal solar energy'.* Order Number DE93744460. Source: OSTI; NTIS (US Sales Only).

The author reports on extended experimental and analytical studies for the development of high-performance collectors in the temperature range up to 200degC. Thermal losses and efficiencies are studied comparatively for a single-pane flat-plate collector with selective absorber coating and different transparent thermal insulations in the temperature range up to c. 90degC. The expected annual energy gains of these collectors are determined as a function of installation site. The results of heat loss and efficiency measurements demonstrate the good performance of a CPC collector within a temperature range of up to 170degC which was developed at the ISFH institute, Hanover. (orig.).

5302 (CONF-9205279–, pp. 279-290) **Optical efficiencies of flat-plate-type and evacuated-tube-type collectors in a comperative study.** Hopp, R. (Fachhochschule Rheinland-Pfalz, Bingen (Germany). Transferstelle fuer Regenerative Energiesysteme, Neue Werkstoffe und Neue Verfahren); Schaumann, G. Ostbayerisches Technologie-Transfer-Institut e.V. (OTTI), Regensburg (Germany). 1992. 304p. (In German). From 2. national symposium on thermal solar energy (TSE); Staffelstein (Germany); 14-15 May 1992. In *Second national symposium 'Thermal solar energy'.* Order Number DE93744460. Source: OSTI; NTIS (US Sales Only).

The authors calculate the optical efficiency of flat-plate-type and tube-type collectors for the incident angles in the daily course, and assess the value for diffuse irradiation. They examine the percentage of the light reflected by the glass cover which can be absorbed in addition. They find that the additional energy gain from reflected light will improve the optical efficiency of evacuated tube collectors by just a few percents, however, by a much higher percentage when incidents angles are greater, compared to flat-plate collectors. (BWI).

5303 (DTH-LV–91-4) **Calculation of the output of Aidt solar heating system's low flow prototype with an electric cartridge.** Furbo, S.; Berg, P.; Carlsson, P. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Varmeisolering. Jan 1991. 34p. (In Danish). Order Number DE93752988. Source: OSTI; NTIS.

The calculation of output of the Danish firm "Aidt miljoe ApS's" marketed low flow solar heating system is described in detail. In September, 1990, a series of detailed measurements were taken on a prototype of an Aidt Miljoe low flow solar heating system. The system is described. A simulation model was developed for a small low-flow system with a covered container for heat storage and used for the calculation of the system's output during the measuring period. This model is also described in detail. Calculated and measured production data are compared and the annual output of the solar heating system is then calculated. The compiled data are presented in detail. (AB).

5304 (DTH-LV–91-22) **The thermal performance of small low flow solar heating systems.** Furbo, S.; Fagerlund Carlsson, P. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Varmeisolering. Nov 1991. 53p. Order Number DE93752989. Source: OSTI; NTIS.

Detailed measurements for a small low flow solar heating system for domestic hot water supply were carried out. A detailed mathematical model simulating the thermal behaviour of a small low flow solar heating system based on a mantle heat storage was validated by means of the measurements. It was investigated how the thermal performance of low flow system is influenced by variations of the solar irradiance caused by clouds. A figure showing the extra yearly thermal performance of low flow systems caused by these variations was prepared. First the yearly thermal performance was calculated with the model and the Danish Test Reference Year, which is based on average hourly weather data for all hours during the year. Then the extra thermal performance caused by variations in the solar irradiance was determined by means of the above mentioned figure. The thermal performances of low flow systems and of traditional solar heating systems have been calculated. Especially for small solar fractions an for small ratios between the hot water consumption and the solar collector area the extra performance of the low flow system compared to the performance of the traditional solar heating system is significant. By means of the validated mathematical model a number of calculations with different system designs were carried out. Based on these calculations figures showing the yearly thermal performance of differently designed low flow systems have been prepared. (AB).

5305 (ETDE-mf–93744442) **Demonstration of performance and adaptability of the Helioman-M480 collectors for process steam generation at temperatures up to 300degC. Final report.** Heinzel, V. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Reaktorentwicklung (IRE); Bundesministerium fuer Forschung und Technologie, Bonn (Germany). [1992] 185p. (In German). Contract BMFT 03E8550A. Order Number DE93744442. Source: OSTI; NTIS (US Sales Only).

The project aimed at the installation of a demonstration plant with MAN-Helioman-M480 solar collectors in order to support the market penetration with those systems in Turkey. Secondly an economic evaluation of one- and two-circuit systems should be elaborated. Therefore, at the terrain of the Marmara University at Istanbul solar systems with Helioman-M480 and two different types of boiling water collectors were installed and taken into operation. Due to shortages of personnel start up of experimental work is still pending. However, the layout of the plant provided already some interesting results. E.g. a proper choice of components and heat transfer media for the primary circuit of the Helioman-M480 collectors reduced the pump power compared to earlier plants remarkably. Therewith, a photovoltaic power supply for the pump should be possible. The development of the boiling water collectors at Karlsruhe revealed, that stable two-phase natural convection could be mastered with several collector geometries. With the underpressure absorber tubes solar process steam production in the power range of some 10 kW should become competitive. (orig.) With 34 refs.

5306 (SAND–92-0300C) **The USDOE Reflux Receiver Development Program.** Klimas, P.C. (Sandia National Labs., Albuquerque, NM (United States)); Andraka, C.E.; Moreno, J.B.; Bohn, M.S. Sandia National Labs., Albuquerque, NM (United States). [1992]. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-920938–4: 6. international symposium on solar thermal concentrating technologies, Mojacar (Spain), 25 Sep - 2 oct 1992). Order Number DE93003244. Source: OSTI; NTIS; GPO Dep.

The US DOE's Solar Thermal Electric Program, through its Sandia and Renewable Energy National Laboratories, has been actively developing liquid metal reflux receivers for application to modular parabolic dish concentrator/Stirling cycle converter solar energy systems. These systems are intended for use in high-value remote and grid-connected utility applications. The liquid-metal reflux-receiver concept was selected because this type of solar receiver (1) can optically mate a given dish with a given engine, and (2) can provide an isothermal environment for the high-temperature heat-input portion of the I engine, thus enhancing reliability. The Program is investigating two types of reflux receivers: heat pipes and pool boilers. Sintered-nickel-wick sodium heat-pipe receivers rated at 30 kW_t have been extensively tested as part of DOE/Cummins cooperative commercialization programs. One recent test article was tested at rated and power temperature for 500 hours. This same receiver demonstrated a 40 kW_t throughput, believed to be the most ever for a solar heated heat-pipe receiver. Another 30-kW_t sodium heat-pipe receiver, this one using a stainless-steel-screen wick design, was also tested as part of these cooperative programs. Much of experimental reflux receiver work conducted at the program's laboratories involves the pool-boiler concept. During nearly 50 hours of solar testing, the Sandia 75-kW_t pool-boiler receiver demonstrated stable sodium boiling over a wide range of temperatures. Hot restarts after simulated cloud passages were investigated using various quantities of added non-condensible gases. Novel x-ray techniques provided information on instantaneous void fractions in the receiver. Present work is focusing on longer lived designs having low-cost, high-strength boiling surface enhancements and using eutectic NaK as the working fluid. The paper will summarize the developments leading to the present and describe future plans.

5307 (SAND–92-0604C) **The status of photovoltaic concentrator development.** Maish, A.B. Sandia National Labs., Albuquerque, NM (United States). [1992]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-921010–1: 11. European photovoltaic solar energy conference and exhibition, Montreux (Switzerland), 12-16 Oct 1992). Order Number DE93002298. Source: OSTI; NTIS; GPO Dep.

Several companies in the United States are actively pursuing the commercialization of photovoltaic concentrator technology. Under the auspices of the US Department of Energy's Concentrator Initiative, the Electric Power Research Institute's High Concentration Photovoltaic Program and several privately funded programs, these companies are developing a range of designs from low-concentration linear-focus to high-concentration point-focus cells and collectors. Design details and status of each development program is presented.

1420 Heat Storage

Refer also to citation(s) 5295, 5305, 5675, 5787

5308 (DTH-LV–91-5) **Computer-programme for the simulation of the dynamic interaction between solar collectors, storage facilities, the district heating network and household**

consumption: An investigation of the temperature-layer-divided heating and cooling of bore-hole storage facilities and the use of heat pumps in SAESON-SOL. Olesen, O.; Berg, P. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Varmeisolering. Jan 1991. 59p. (In Danish). Contract ENS-UVE-90.0032. Order Number DE93752991. Source: OSTI; NTIS.

The computer-programme SAESON-SOL simulates thermal conditions in larger solar heating systems with seasonal storage facilities which can be either in the form of solar ponds or bore-hole storage. The computerized simulation shows that the solar heating fraction of 70% - 80% can be obtained in the case of reasonably dimensioned solar-pond storage, which is higher than in the case of borehole storage. In relation to the latter there occurs a significant temperature loss as heat transfer takes place via conduction through soil which has a relatively low heat conduction capacity so that the system works at a slow pace. It was attempted to investigate the influence on bore-hole storage capacity when heat pumps are utilized to raise the temperature niveau and thus work towards a reduction of heat loss, an improved solar heating fraction and a lessened risk of boiling. Use of this computerized simulation programme showed that an improved solar heating fraction can be achieved in relation to the borehole storage facilities by utilizing heat pumps. The significant measuring results are presented. (AB).

5309 (DTH-LV–92-10) **Measuring and evaluation of heat storage tank in Hoerby.** Vejsig Pedersen, P. (Cenergia (Denmark)); Kofod, P. Cenergia ApS, Ballerup (Denmark); Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Varmeisolering; Nordvestjysk Folkecenter for Vedvarende Energi, Hurup (Denmark). Mar 1992. 34p. (In Danish). Order Number DE93752971. Source: OSTI; NTIS.

Contract ENS-UVE-89.0246.

The aim was to build a prototype concrete tank which was suitable for the seasonal storage of solar heat. The building material was watertight concrete ("Densit") of the type used for constructing floors and the tank was to be integrated in a district heating plant. Problems arose concerning leaks and cracks in the concrete construction. It was thought that these were caused by an accumulation of water resulting from the use of two kinds of membrane, one of which was more open to diffusion than the other. Measurements were taken during 4 periods from September 20th 1990 until January 3rd 1991. The current of energy and the temperatures in 5 layers of the storage facility were measured. Heat losses were registered as 328 kWh per 24 hours. The fact that this was more than expected was thought to be due to leakage and surface evaporation. The testing confirmed the general suspicion that no usable cheap membranes are currently available. It is suggested that clay-sealing could help to solve the problem of leakage. (AB).

15 GEOTHERMAL ENERGY

1503 Geothermal Exploration and Exploration Technology

Refer also to citation(s) 5311

5310 (DOE/ID/12945–T6) **A study of hydrocarbons associated with brines from DOE geopressured wells: Annual report, December 17, 1991–December 31, 1992.** Keeley, D.F. University of Southwestern Louisiana, Lafayette, LA (United States). Acadiana Research Lab. [1992]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC07-90ID12945. Order Number DE93005643. Source: OSTI; NTIS; GPO Dep.

The objective of the work is to study the production of aromatic hydrocarbons, the mechanism by which they are produced in the reservoir, and their collective properties. The research will be accomplished by collecting samples from DOE design wells, analyzing the hydrocarbons, and monitoring the production of the hydrocarbons from the gas and brine. Data from 210 scrubber samples are presented.

1507 Products and By-Products

Refer also to citation(s) 5310

1509 Geothermal Engineering

5311 (DOE/ID/12945–2) **Aromatic hydrocarbons associated with brines from geopressured wells: Annual report, [December 28, 1990–December 16, 1991].** University of Southwestern Louisiana, Lafayette, LA (United States). Acadiana Research Lab. Sep 1992. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC07-90ID12945. Order Number DE93000933. Source: OSTI; NTIS; GPO Dep.

The various operational wells were sampled on a monthly basis for the yield of the cryocondensate hydrocarbons. The total cryocondensate concentration as well as the concentrations in the brine and the gas after passing the separator system are summarized. The total cryocondensate yield is displayed.

1510 Direct Energy Utilization

Refer also to citation(s) 5858

16 TIDAL AND WAVE POWER

1607 Tidal Power Plants

5312 (ETSU-TID–4101) **Tidal barrage caisson emplacement model tests.** ABP Research and Consultancy Ltd., Southall (United Kingdom). 1992. 111p. Order Number DE93756629. Source: OSTI; NTIS (US Sales Only).

The purpose of this study was to identify problems that may be encountered when placing prefabricated barrage caisson units close to existing caissons during the construction of tidal barrages. The potential for serious damage to occur is greatly increased when manoeuvring caissons into place next to units that are already in position. The specific aims of the study were to: (a) Determine the forces required to hold a caisson in position in a range of constant tidal flows when ballasted to different draughts and restrained by moorings of varying stiffnesses. (b) define the motion of the caisson under the conditions in (a) above and (c) establish the same quantities over the same range of variables in (a) and (b) above when the unit is moored close to caissons that have already been positioned. The study employed conventional hydraulic modelling techniques using a generic caisson model built to a scale of 1:100. The use of a generic model enables the results to be applied to caissons of similar proportions, but different overall dimensions, by the use of simple scaling techniques. (author).

5313 (ETSU-TID–4101B) **Tidal barrage caisson emplacement model tests. Appendix B: Graphical plots.** ABP Research and Consultancy Ltd., Southall (United Kingdom). 1992. 50p. Order Number DE93756630. Source: OSTI; NTIS (US Sales Only).

This Appendix contains the graphical plots associated with a study to identify problems that may be encountered when placing prefabricated barrage caisson units close to existing caissons during the construction of tidal barrages. The study used a generic caisson scale model. The forces in the mooring lines and the motion of the caisson in terms of surge, sway, heave, yaw, pitch and roll are reported. (UK).

1608 Wave Energy Converters

5314 (CTH-VB-A–23) **Energy take-out from a wave energy device.: A theoretical study of the hydrodynamics of a two-body problem consisting of a buoy and a submerged plate.** Berggren, L. Chalmers Univ. of Technology, Goeteborg (Sweden). Dept. of Hydraulics. 1992. 81p. Order Number DE93753077. Source: OSTI; NTIS.

A method for calculating the energy take-out from a single wave energy converter is presented. The converter consists of a buoy connected via a hose pump to a submerged plate. The equations of motion of the buoy and plate are solved linearly in the frequency

domain, which shows that frequency dependent hydrodynamic properties can be used. The hose pump is treated as a complex spring, the real part corresponding to a spring and the imaginary part corresponding to a time independent damping factor. The damping factor multiplied by the amplitude of the hose pump is a measure of the work done by the pump. The drag force is linearized by setting the energy dissipation for a period equal in both the non-linear and the linear cases. The emphasis in this report is placed on the calculation of the frequency dependent hydrodynamic properties, such as the wave excited forces and the hydrodynamic coefficients. The structure is considered to be large in comparison with the wave length and, therefore, the diffraction theory has been used. A method of calculating the forces that act on the bodies is presented, as well as the interaction between the bodies. This two-body problem is solved analytically. The present solution is compared with a numerical one and an analytical one, the latter, however, treats simply a single buoy riding in the waves. The calculated energy take-out of the present model is compared with a time domain dependent model, and reasonable agreement has been found. (7 refs., 18 figs., 2 appendices titled: 'Hydrodynamic coefficients of a wave energy device consisting of a buoy and a submerged plate', and 'Forces on a wave-energy module'.).

17 WIND ENERGY

1701 Resources and Availability (Climatology)

5315 (AUC-IBT-R–9204, pp. 157-167) **The structure of atmospheric turbulence at high wind speeds.** Soerensen, J.M. (Risoe National Laboratory, Roskilde (Denmark)). Aalborg Universitetscenter (Denmark). Inst. for Bygningsteknik. Feb 1992. (CONF-9111281–: 2. Scandinavian forum for stochastic mechanics, Aalborg (Denmark), 21-22 Nov 1991). In *Scandinavian forum for stochastic mechanics.* 170p. Order Number DE93752802. Source: OSTI; NTIS.

Diagrams and mathematical equations illustrate means of defining atmospheric turbulence at high wind speeds. Isotropic turbulence in the inertial sub-range, and shear-turbulence interaction are dealt with. The conclusion is that linearized theory gives a rough undertanding of the (2.order) structure of atmospheric turbulence. (AB).

5316 (ETDE-mf–93744396) **Utilization of wind power in Hesse - climatological aspects. Wind climatology.** Kumm, H.; Kern, W. Oeko-Institut, Inst. fuer Angewandte Oekologie e.V., Freiburg im Breisgau (Germany); Ministerium fuer Umwelt, Energie und Bundesangelegenheiten des Landes Hessen, Wiesbaden (Germany). Aug 1991 189p. (In German). Order Number DE93744396. Source: OSTI; NTIS (US Sales Only).

The study is part of a Hessian project on wind power utilization in the central regions of Hesse. The wind measurement results and practical schemes presented in parts I and II provide the basis for the reliable and climatologically verified wind data and the derived climatological siting criteria compiled in part III. Recommendations for the proper selection and integration of wind power plants are worked out for typical sites in Hesse to guide interested investors in the necessary site selection and preliminary planning procedures. (orig./KW).

1704 Economic, Industrial, and Business Aspects

Refer also to citation(s) 5758

5317 (CONF-9101154–, pp. 101-112) **Wind power plants.** Hau, E. (ETA GmbH, Muenchen (Germany)). Bayerisches Staatsministerium fuer Wirtschaft und Verkehr, Muenchen (Germany). 1991. 306p. (In German). From Symposium on incentives for using renewable energy sources in Bavaria; Coburg (Germany); 28-29 Jan 1991. In *Incentives for using renewable energy sources in Bavaria. Symposium for users and suppliers (local authorities, public utilities, industry, medium enterprises).* Order Number DE93744689. Source: OSTI; NTIS (US Sales Only).

Wind power technology has entered into a new phase due to the initiation by the large-scale test programme implemented by the Federal Ministry for Research and Technology (BMFT). Technological development used to be pursued in two ways. First, large-sized wind power plants with outputs of several MW's and secondly, much smaller sized plants which were preferably used in Denmark. WPP's with an output between 200 and 400 kW have reached a level of engineering maturity which allows their profitable application. An EC-commissioned study to be published soon on the development of wind powers utilization in Europe, will demonstrate the potential of wind energy in the EC countries. About 4000 MW of wind power is expected to have been installed as systems and plants by the year 2000. (BWI).

5318 (NEI-DK–980) **Quality control within the windmill branch: Final report.** S og Q Tech A/S, Vejen (Denmark). Aug 1990. 87p. (In Danish). Order Number DE93752754. Source: OSTI; NTIS; INIS.

The aim of the project was to improve the quality of Danish-produced wind turbines by initiating quality control and working out general technical guidelines compatible with European standards so that these products can be authorized internationally. Guidelines for blade production, and purchase of gear boxes are presented in addition to an explanation of the concept of quality control. Administrational procedures in relation to authorization are also explained. (AB).

1706 Wind Energy Engineering

Refer also to citation(s) 5316, 5733, 6069

5319 (ECN-C–92-054) **Power factor and power control of the boost rectifier and the chopper controlled rectifier.** Veltman, A.T.; De Haan, S.W.H. Netherlands Energy Research Foundation (ECN), Petten (Netherlands). Aug 1992. 21p. Contract CEC JOULE/JOUR-0082;Project ECN 4162. Order Number DE93752680. Source: OSTI; NTIS (US Sales Only).

A power factor analysis of the input part of an advanced AC/DC/AC converter for variable speed wind turbines is presented. Two types of rectifying input converters are compared: the boost rectifier, consisting of three AC inductors, a three-phase diode bridge and a switching element to obtain voltage boost chopper behavior; and a conventional diode bridge rectifier, followed by a voltage boost chopper. Most of the analysis is focused on the boost rectifier analysis, of which the power factor and the distortion factor are derived. It follows that for a synchronous generator without damper windings, the boost rectifier seems a good solution for both a high power factor (maximally 0.955) and voltage (boost) control capability. For a synchronous generator with damper windings, however, the conventional diode bridge rectifier, followed by a voltage boost chopper, yields the best power factor. For the boost rectifier, an analytical expression for the chopper switch current demand as a function of the AC power demand and generator rotational speed is given. 13 figs., 1 tab., 1 app.

5320 (ETDE-mf–93742738) **Intermediate circuit inverter for controlling a nongeared wind energy plant with a permanent magnet-excited synchronous generator.** Landrath, J. Technische Univ. Braunschweig (Germany). Fakultaet fuer Maschinenbau und Elektrotechnik. 20 Aug 1991 173p. (In German). Order Number DE93742738. Source: OSTI; NTIS (US Sales Only).

In this work, the operating behaviour of a directly driven generator system, consisting of a permanent magnet excited synchronous machine and intermediate circuit inverter is examined theoretically and practically. Three different versions of intermediate circuit inverters were considered as the setting member of a variable speed energy plant. Various processes are possible for the optimum control of the wind energy plant. The inverter variant with the best properties uses a four quadrant setter as the machine side rectifier, a voltage intermediate circuit and a mains inverter. A field experiment of the FLAIR 8 wind turbine with the directly driven generator and the inverter system concludes the investigation. (orig./BWI).

5321 (ETSU-WN–6022) **Feasibility study of teetered, stall-regulated rotors.** Armstrong, J.R.C.; Hancock, M. Wind Energy

Group Ltd., Southall (United Kingdom). 1991. 94p. Order Number DE93756634. Source: OSTI; NTIS (US Sales Only).

The purpose of this study was to examine the feasibility of a two-bladed teetered stall-regulated rotor for wind turbines, the cost benefits which might be expected in commercial application, and how such a configuration might be demonstrated. The study and its conclusion have been based on a reference design of a 33 m, 400-500 kW machine. (author).

5322 (ETSU-WN–6043) **Report on the passive control of horizontal axis wind turbines.** Corbet, D.C.; Morgan, C.A. Garrad, Hassan and Partners, Bristol (United Kingdom). 1992. 133p. Order Number DE93756633. Source: OSTI; NTIS (US Sales Only).

The work presented in this report is concerned with the passive control of power and loads on horizontal axis wind turbines. A review of machines which use passive control techniques is presented along with an exploration of their success or failure in practice. A mathematical model of a wind turbine has been constructed and each of the possible ways to use the forces acting on the wind turbine has been investigated in a systematic manner. In this way a very broad range of possible passive control schemes has been considered. These include methods which use passive pitching to both stall and fine pitch. blade coning and drive train flexibility. Both fixed speed and variable speed operation have been considered. The characteristics of the power control and of loads at the rotor and the drive train have been established. These have been compared with those for a typical active pitch controlled machine. Static and dynamic characteristics have been considered. An assessment of the likely complexity of each type of system has been made. This is compared to the complexity inherent in an active, pitch controlled machine and a stall regulated machine. (author).

5323 (NEI-DK–994) **Kinematically nonlinear finite element model of a horizontal axis wind turbine. Part 1: Mathematical model and results.** Thirstrup Petersen, J. Risoe National Lab., Roskilde (Denmark). Meteorology and Wind Energy; Danmarks Tekniske Hoejskole, Lyngby (Denmark). Jul 1990. 152p. Order Number DE93752755. Source: OSTI; NTIS.

A mathematical time domain model for simulation of the dynamic response of a horizontal axis wind turbine is presented. The model concentrates on the correct representation of the inertial loads in the equations of motion. A general kinematic analysis is the basis for the derivation of the local inertia loads. Nonlinear kinematic terms are retained in the expressions for these loads. The wind turbine structure is divided into three substructures comprising the tower, the nacelle-shaft and the rotor, each with reference to a local coordinate system. General element inertia matrices and vectors are derived through consistent transformation of the inertia loads to the nodes. Final assembley of the substructure equations of motion is carried through by imposing force equilibrium at the coupling nodes. Sub-structuring permits easy updating corresponding to rigid body rotations of the substructures and extends the limitations of the allowable displacements. The loading on the wind turbine structure includes both the gravity and aerodynamic loads. The model is fully aero-elastic. The free wind vector is composed of a deterministic contribution - including wind shear and tower interference - and a stochastic component obtained by simulation of turbulence. Based on the mathematical model, a computer programme has been developed. Results from simulation of the response on a typical Danish three-bladed, stall regulated wind turbine are presented and compared with measurements. (au) (47 refs.).

5324 (NEI-DK–995) **Kinematically nonlinear finite element model of a horizontal axis wind turbine. Part 2: Supplement. Inertia matrices and aerodynamic model.** Thirstrup Petersen, J. Risoe National Lab., Roskilde (Denmark). Meteorology and Wind Energy; Danmarks Tekniske Hoejskole, Lyngby (Denmark). Jul 1990. 92p. Order Number DE93752758. Source: OSTI; NTIS.

This supplement contains some of the most space-consuming inertia matrices derived for the mathematical model of a horizontal axis wind turbine. One is the general inertia matrix, from which the mass, Coriolis and softening matrices are derived. These matrices are coefficients to local substructure degrees of freedom. Other matrices are resulting from extraction of degrees of freedom from enertia vectors, which originate directly from the consistent transformation of the inertia load to the nodes of the beam finite element. These matrices are coefficients to degrees of freedom outside the local substructure. They depend on the actual choice of degrees of freedom and the actual linearization introduced by cancelling of higher order product terms of the degrees of freedom and their time derivatives. The origin of the matrices is explained and some of the most important algebraic manipulations are shown. Further, the complete description of the aerodynamic model is contained in this supplement. A procedure for time simulation of turbulence is part of the model. (au) (46 refs.).

5325 (NEI-DK–1003) **Turbulence: Determination of the contribution to wind turbulence caused by adjacent turbines in wind turbine arrays.** Gjerding, J.B. Tripod Wind Energy ApS, Soeborg (Denmark). Sep 1992. 45p. (In Danish). Order Number DE93752810. Source: OSTI; NTIS.

This report discusses the contribution to wind tubulence caused by aduacent turbines in wind turbine arrays.

5326 (NEI-DK–1018) **The Tjaereborg wind turbine: Final report.** Elsamprojekt A/S, Fredericia (Denmark). Sep 1992. 104p. Contract EN3W-0048-DK. Order Number DE93752793. Source: OSTI; NTIS.

The cooperation between the Danish Ministry of Energy and the electric utilities started in 1976 with a joint programme directed towards the development of large wind turbines, their siting and integration in the electric grid. The Tjaereborg wind turbine, a 3-bladed, horizontal axis turbine with the blades placed upwind and full span pitch control for power regulation and with the nacelle placed on a concrete tower, was connected to the electric grid in 1988. It finally came into stable operation in late 1990 after severe technical problems with the control system and gearbox. Rotor diameter is 61.1 m, blade profile is NACA 4412-43, blade length - 29 m, solidity - 5.9%, nominal speed at rated power - 22.36 rpm, tilt angle - 3 deg., hub height - 60 m. The design is based on experience gained from NIBE wind turbines. After 2 1/2 years with serious technical problems, in 1991 the turbine was released for automatic unmanned operation for 10117 hours. The general conclusion is that the electricity-producing wind turbines in the multi MW class are a viable technical possibility although the Tjaereborg turbine represents the wind turbine technology of the early eighties. A detailed technical description of this turbine is given in addition to a description of the main problems previously encountered. The system of measurement, site characteristics, operation and production, the power curve, noise emission, optimization of operation and loads are also dealt with in detail. (AB) (32 refs.).

5327 (NREL/TP–257-4655) **Combined Experiment Phase 1: Final report.** Butterfield, C.P.; Musial, W.P.; Simms, D.A. National Renewable Energy Lab., Golden, CO (United States). Oct 1992. 220p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE93000012. Source: OSTI; NTIS; GPO Dep.

How does wind tunnel airfoil data differ from the airfoil performance on an operating horizontal axis wind turbine (HAWT)? The National Renewable Energy laboratory has been conducting a comprehensive test program focused on answering this question and understanding the basic fluid mechanics of rotating HAWT stall aerodynamics. The basic approach was to instrument a wind rotor, using an airfoil that was well documented by wind tunnel tests, and measure operating pressure distributions on the rotating blade. Based an the integrated values of the pressure data, airfoil performance coefficients were obtained, and comparisons were made between the rotating data and the wind tunnel data. Care was taken to the aerodynamic and geometric differences between the rotating and the wind tunnel models. This is the first of two reports describing the Combined Experiment Program and its results. This Phase I report covers background information such as test setup and instrumentation. It also includes wind tunnel test results and roughness testing.

5328 (NUTEK-VIND–92-9) **Fatigue loads on wind turbine blades in a wind farm.** Poppen, M.; Dahlberg, J.Aa. Swedish National Board for Industrial and Technical Development (NUTEK), Stockholm (Sweden); Aeronautical Research Inst. of Sweden,

Bromma (Sweden). Jun 1992. 31p. Project NUTEK-506-266. (FFA-TN–92-21). Order Number DE93753079. Source: OSTI; NTIS.

This paper presents the flap moment load spectrum in the blades on turbines operating in a wind farm and comparisons are made with a single turbine. The Swedish State Power Board is operating a small wind turbine farm situated at Alsvik on the west coast of the island of Gotland in the Baltic Sea. The farm consists of four Danwin 23/180 kW turbines. Three turbines are placed close to the shoreline in a row that runs approximately in the nort-south direction. The fourth turbine is placed to the east of the row so that the distances to the other turbines are 5, 7 and 9.5 turbine diameters. The prevailing wind direction is south-west which means that the fourth turbine often operates in the wake of another turbine. The site is favourable for wake studies since the surrounding terrain is flat and the wind often blows from the open sea. The influence of wakes on the load spectrum is important to take into account. Especially for offshore sites where the surrounding terrain does not give high load cycles due to high turbulence intensity or high wind shear. This study shows that also wakes from 9.5 diameters distance give significantly higher loads. (2 refs., 28 figs.).

5329 (RISO-R–606) **Performance testing of NTK 3.2 WP wind pump with 3.2 m windflower rotor.** Voelund, P. Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Mar 1992. 36p. (In Danish). Contract ENS-UVE-90.0083. Order Number DE93752741. Source: OSTI; NTIS.

This report describes the testing of a Nordtank prototype wind pump, NTK 3.2 WP at The Test Station for Wind Turbines, Risoe. The wind pump design is based on the Windflower-rotor combined with a piston pump through a gearbox. The tested version of the wind pump is designed for surface pumping. In the beginning of the test period some problems showed up with the functioning of the turbine. These were overcome by changing from a double acting to a single acting piston pump, and by design modifications to the yaw vane. The wind pump was afterwards in operation for four months. But not completely without operational problems. The report contains results from comparisons between calculations and measurements of the efficiency and the starting torque, some investigations of the force in the pump rod including fatigue Rainflow spectre and the behavior of the yawing system in different versions. The total efficiency in terms of water supply is quite high and comparable to Dutch CWD wind pumps, however, lower than expected from the calculated rotor efficiencies. (au) (1 tab., 35 ills., 5 refs.).

5330 (RISO-R–617) **Dynamics of a two-bladed teetering rotor.** Rasmussen, F.; Kretz, A. Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Jun 1992. 58p. Contract ENS-1364/90-0007. Order Number DE93752751. Source: OSTI; NTIS.

EFP-90.

The aim of the project was to identify possible potentials for the stall regulated two bladed teetering rotor turbine in comparison to the three bladed Danish standard design. An aeroelastic prediction code, Mr. Swing, has been developed. A verification of this code is made by measurements on a research turbine equipped with a two bladed teetering rotor in a variety of configurations. The rotor used is from a former commercial turbine, the Windane 12, which is 12 m in diameter. The hub has been modified in order to allow for a variation of the teeter stiffness and damping characteristics. The effort is mainly on a verification of the aeroelastic code's ability to describe the dynamics of the turbine, and especially the rotor, which depends strongly on teeter stiffness and damping: The rotor is stable in yaw with free teeter or low stiffness or damping but unstable with the rigid hub configuration. The yaw error is as high as -30 degrees in this case, and with an exceptionally high standard deviation. This is also predicted by the aeroelastic code. The cyclic blade loads are minimal with low teeter stiffness and approximately five times higher with the rigid hub. However, this is to some extent caused by the high yaw error due to the unstable yaw. The main advantage with the teetering rotor compared to the rigid hub concerning blade loads is that it eliminates the 1p cyclic variation from wind shear, both mean wind shear from vertical wind gradient and turbulent shear. It also eliminates the 1p content from yawed flow, however, in partly stalled operation, a similar variation is created at 2p, which means that with respect to this situation, it represents no advantage. The report further describes a theoretical comparison between two- and three-bladed wind turbines. (au) (12 tabs., 66 ills., 9 refs.).

5331 (RISO-R–630) **Technical report for the activities at The Test Station for Wind Turbines in 1991.** Harvoee, P. Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. May 1992. 33p. (In Danish). Order Number DE93752742. Source: OSTI; NTIS.

The aim of The Test Station for Wind Turbines is to contribute to improve wind turbines and be a technology center of knowledge concerning wind turbines. As in previous years a joint report has been made for the activities at the Test Station for Wind Turbines in a way which gives a reasonable survey. The report contains a description of the activities in the Danish energy research projects and EEC financed research project which are placed at The Test Station. A short review is given for all the activities and for some of the results achieved with reference to the report in which a comprehensive description is given. Besides a review is given for the activities concerning the approval system for wind turbines, which includes approval and testing of wind turbines and international cooperation. Different activities diverted is described. (au).

5332 (SAND–91-7012) **Stress calculation for the Sandia 34-meter wind turbine using the local circulation method and turbulent wind.** Masse, B. (Institut de Recherche d'Hydro-Quebec, Varennes, PQ (Canada)); Pastorel, H. Sandia National Labs., Albuquerque, NM (United States); Institut de Recherche d'Hydro-Quebec, Varennes, PQ (Canada). Nov 1992. 108p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93004480. Source: OSTI; NTIS; GPO Dep.

Stress calculation for wind turbine blades is an important task for the manufacturers of wind turbines. A good prediction of stress level is required to tabulate the fatigue life of the rotor. Design of critical blade joints is based on such calculations. Aerodynamic loads and atmospheric turbulence have been identified as important factors in estimating fatigue damage. This report describes a stress estimate procedure and its application to the Sandia/DOE34-meter wind turbine. The procedure uses the computer code developed at IREQ (MCL) for aerodynamic load calculation including atmospheric turbulence. Aerodynamic loads are decomposed into modal components and applied to structures using the finite element program NASTRAN. Rotating modes are computed as a linear composition of stationary modes. The stress distributions as functions of frequency are extracted from the modal frequency response for critical locations on the blade. Stress distributions are calculated for the first five harmonics of the rotational speed and for off-harmonic frequencies. Calculated stress amplitude spectra are compared with Malcolm's results and with test data. The results indicate that improved aerodynamic loading is obtained from MCL and that aeroelastic effects needs to be added to obtain better agreement.

5333 (SAND–92-1162C) **Advanced control strategies for wind turbines.** Schluter, L.L. (Sandia National Labs., Albuquerque, NM (United States)); Vachon, W.A. Sandia National Labs., Albuquerque, NM (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-921049–4: Windpower '92, Seattle, WA (United States), 19-23 Oct 1992). Order Number DE93003252. Source: OSTI; NTIS; GPO Dep.

As wind turbines become more complex and begin to incorporate variable speed operation, control algorithms that enable the wind turbine to operate as efficiently as possible will become more complicated. Also, most current control strategies do not take into account factors such as wake effects from upstream turbines and the fact that different turbine sites can have significantly different wind regimes. To aid a windfarm operator in developing appropriate control strategies, a computer code entitled ASYM has been developed at Sandia National Laboratories. ASYM is a wind turbine simulation program that can be used to evaluate different control strategies. This paper briefly describes ASYM and presents results from the code when used for evaluating control options for both variable-speed and constant-speed control. The codesynthesizes dynamic wind speeds on a second-by-second basis in the time domain that conforms to a predetermined spectral content governed

by the surface roughness length scale and the hourly average wind speed.The simulated wind speeds then drive a series of wind turbine (WT) control algorithms that predict key WT operational parameters such as number of annual starts and stops, annual energy production, and annual fatigue damage at a critically stressed joint on the WT. This paper also discusses future plans to improve and validate ASYM and to incorporate a comprehensive economics model and advanced control strategies such as fuzzy control, adaptive control, and expert systems. It has been shown that processes using fuzzy control algorithms operate more smoothly and more efficiently than processes that are controlled using classical methods. Fuzzy control is briefly explained and an example of its application to a wind turbine is given. The future plans include a continuing involvement with active wind plant operators who can providefeedback regarding the usefulness of the analytical tool and the validity of findings.

5334 (SAND–92-1665C) **Effect of the flap and edgewise bending moment phase relationships on the fatigue loads of a typical HAWT blade.** Sutherland, H.J. Sandia National Labs., Albuquerque, NM (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930153–1: 12. American Society Mechanical Engineers wind energy symposium, Houston, TX (United States), 31 Jan - 4 feb 1993). Order Number DE93003253. Source: OSTI; NTIS; GPO Dep.

The load spectrum unposed upon a horizontal-axis wind turbine blade is typically decomposed into two primary bending moments; flap and edgewise bending. The critical fatigue loads (stress cycles) imposed on the blade may not be on one of these axes, especially if die two bending loads are in-phase with one another. To quantify the correlation of these two bending moments and determine the impact of this correlation on off-axis" fatigue loads, an extensive data set for a typical wind turbine blade is examined. The results are compared using their respective cycle count matrices. These results illustrate that the harmonic components of die principal bending stresses are correlated, and that the random components are not. The analysis techniques described in the paper provide the turbine designer with a spectral technique for combining primary bending spectra into off-axis fatigue loads.

5335 (SAND–92-2417C) **A non-contact blade surface mapping system.** Berg, D.E. (Sandia National Labs., Albuquerque, NM (United States)); Stephenson, W.A.; Clark, R.N.; Mulh, K.E. Sandia National Labs., Albuquerque, NM (United States). [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-921049–5: Windpower '92, Seattle, WA (United States), 19-23 Oct 1992). Order Number DE93004049. Source: OSTI; NTIS; GPO Dep.

A non-contact, high-resolution laser ranging device has been incorporated into an instrument for accurately mapping the surface of WECS airfoils in the field. Preliminary scans of composite materials and bug debris show that the system has adequate resolution to accurately map bug debris and other surface contamination. This system, just recently delivered and now being debugged and optimized, will be used to characterize blade surface contamination on wind turbines. The technology used in this system appears to hold promise for application to many other measurements tasks, including a system for quickly and very accurately determining the profile of turbine blade molds and blades.

5336 (VTT-TIED–1354) **Wind power plants in the weather conditions of Northern Finland.** Boehmeke, G. (Technical Research Centre of Finland, Espoo (Finland). Lab. of Electrical and Automation Engineering). Technical Research Centre of Finland, Espoo (Finland). 1992. 95p. Order Number DE93752927. Source: OSTI; NTIS.

Lappland's fells and highlands feature a notable wind power potential due to special meteorological circumstances. The wind power plants for these sites must be equipped with special means against icing and low temperatures. Icing events monitored on a small test machine are described and compared with general load assumptions. Different means of ice detection and ice removal from rotor blades are presented. Low temperature and anti-icing requirements for wind power plant components and operation control are discussed.

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Refer also to citation(s) 4866, 4868, 4878, 4880, 4881, 4883, 4897, 5260, 5380, 5745, 5746, 5749

5337 (DOE/EIA–0095(91)) **Inventory of power plants in the United States, 1991.** USDOE Energy Information Administration, Washington, DC (United States). Office of Coal, Nuclear, Electric and Alternate Fuels. 30 Oct 1992. 412p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93002934. Source: OSTI; NTIS; INIS; GPO; GPO Dep.

Operable capacity at US electric power plants totaled 693,016 megawatts, as of year-end 1991. Coal-fired capacity accounted for 43 percent (299,849 megawatts) of the total US generating capacity, the share it has essentially maintained for the past decade. Gas-fired capacity accounted for 18 percent (125,683 megawatts); nuclear, 14 percent (99,589 megawatts); water, 13 percent (92,031 megawatts); petroleum, 10 percent (72,357 megawatts); other, one percent (3,507 megawatts). The 693,016 megawatts of operable capacity includes 3,627 megawatts of new capacity that came on line during 1991 (Table 2). This new capacity is 42 percent less than capacity in new units reported for 1990. Gas-fired capacity accounted for the greatest share of this new capacity. It represents 38 percent of the new capacity that started operation in 1991. The surge in new gas-fired capacity is the beginning of a trend that is expected to exist over the next 10 years. That is, gas-fired capacity will dominate new capacity additions. Gas-fired capacity additions during the next 10 years will primarily be in simple cycle gas turbines and gas turbines operating as combined cycle units. These planned gas turbine and combined cycle units, whose capacity totals over 21,000 megawatts, are expected to serve peak and intermediate loads of electric utilities.

5338 (DOE/FE/61660–93/C0093) **Sensitivity of hot gas desulfurization on IGCC cost of electricity.** Rutkowski, M.D.; Chen, H.T.; Klett, M.G. Gilbert/Commonwealth, Inc., Reading, PA (United States). [1992]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC01-88FE61660 ;AC01-88FE61662. (DOE/FE/61662–93/C0093;CONF-920951–44: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93002730. Source: OSTI; NTIS; GPO Dep.

The results of the second study indicated that the COE with fluidized bed desulfurization can be competitive with the moving bed concept. Table 7 is a comparison of the relative performance and costs associated with both processes. A comparison is made between the two eastern coal concepts from the moving bed study with three of the fluid bed regenerations and the riser tube. It can be seen that the net power output falls within a narrow range of from 186.8 to 189.8 MWe, and that the efficiencies of the acid plants (39 percent) and the DSRP plants (37.5 percent) are comparable. It can also be seen that the fluidized bed and moving bed processes are comparable in cost, with both H_2SO_4 plants having a COE of 72.0 and 71.9 mills per kWh. Table 8 is a comparison of the sensitivity of the COE for these plants relative to desulfurization parameters. Since base case costs and performance were comparative, so also were the associated sensitivities. Areas which significantly affect the sulfur removal and recovery areas include sorbent life, sorbent circulation rate, sorbent cost, capacity factor, sorbent utilization, and attrition rate. These parameters can be consolidated into the sorbent replacement rate which is the parameter that directly impacts sorbent O&M replacement cost. Figure 10 shows the sensitivity of COE as a function of sorbent replacement rate, i.e., inventory replacements per year for both the moving bed and fluidized bed cases producing sulfuric acid. It can be seen that, although the moving bed and fluidized bed plant concepts have comparable COE's at their respective base-case conditions, the sensitivity of each COE to operating parameters is such that the COE differential can be significant.

5339 (DOE/MC/29309–93/C0083) **Pinon Pine IGCC project status update, August 1992.** Motter, J.W.; Pitcher, J.D.;

Fankhanel, M.; Campbell, W. Sierra Pacific Power Co., Reno, NV (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC21-92MC29309. (CONF-920951–22: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93002618. Source: OSTI; NTIS; GPO Dep.

Since the recent (August, 1992) execution of the Cooperative Agreement, the major focus of work has been on critical-path environmental permitting activities, both related to the NEPA process as well as state and local activities. Pending approval of the project by the Nevada Public Service Commission, detailed engineering activities will commence in November. Federal funding of the project automatically invokes environmental review under the National Environmental Policy Act (NEPA). This project will require an Environmental Impact Statement, or EIS, with DOE as the lead agency for the NEPA reviews. The project must also be approved by the Nevada Public Service Commission (PSCN) in the state's Resource Planning process. As shown in the project schedule, Figure 4 below, SPPCo. expects to have the combustion turbine portion of the plant on line by late 1994, configured as a simple-cycle natural gas machine with either No. 2 diesel or propane being utilized as backup fuel. By phasing construction in this manner, SPPCo. gains approximately 45 MWe of peaking power capacity to match projections of customer loads. The gasifier, heat recovery steam generator (HRSG), and the balance of the IGCC plant will be commissioned in late 1996. A DOE demonstration period of 42 months is planned.

5340 (DOE/MC/29444–93/C0085) **Toms Creek IGCC Demonstration Project.** Virr, M.J. TAMCO Power Partners, Marietta, GA (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC21-93MC29444. (CONF-920951–10: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93002743. Source: OSTI; NTIS; GPO Dep.

The Toms Creek Integrated Gasification Combined Cycle (IGCC) Demonstration Project was selected by DOE in September 1991 to participate in Round Four of the Clean Coal Technology Demonstration Program. The project will demonstrate a simplified IGCC process consisting of an air-blown, fluidized-bed gasifier (Tampella U-Gas), a gas cooler/steam generator, and a hot gas cleanup system in combination with a gas turbine modified for use with a low-Btu content fuel and a conventional steam bottoming cycle. The demonstration plant will be located at the Toms Creek coal mine near Coeburn, Wise County, Virginia. Participants in the project are Tampella Power Corporation and Coastal Power Production Company. The plant will use 430 tons per day of locally mined bituminous coal to produce 55 MW of power from the gasification section of the project. A modern pulverized coal fired unit will be located adjacent to the Demonstration Project producing an additional 150 MW. A total 190 MW of power will be delivered to the electric grid at the completion of the project. In addition, 50,000 pounds per hour of steam will be exported to be used in the nearby coal preparation plant. Dolomite is used for in-bed gasifier sulfur capture and downs cleanup is accomplished in a fluidized-bed of regenerative zinc titanate. Particulate clean-up, before the gas turbine, will be performed by high temperature candle filters (1020°F). The demonstration plant heat rate is estimated to be 8,700 Btu/kWh. The design of the project goes through mid 1995, with site construction activities commencing late in 1995 and leading to commissioning and start-up by the end of 1997. This is followed by a three year demonstration period.

5341 (DOE/METC/C–93-7038) **Experience with high temperature dust filtration in coal gasification systems.** Epstein, M. (Electric Power Research Inst., Palo Alto, CA (United States)); Rath, L.K. Electric Power Research Inst., Palo Alto, CA (United States); USDOE Morgantown Energy Technology Center, WV (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). (CONF-921037–8: 9. annual international Pittsburgh coal conference, Pittsburgh, PA (United States), 12-16 Oct 1992). Order Number DE93002399. Source: OSTI; NTIS; GPO Dep.

This paper tabulates the major experience and future plans worldwide for high temperature filtration of dust-laden gases from coal gasification systems. Past and current experience tabulated includes the hot filtration of gases from entrained-flow and fluidized-bed gasifiers, ranging in capacity between 2 and 700 ton/day coal feed and with operating pressures between 10 and 25 bars. GCC power plants are competitive with conventional coal-based power plants with scrubbers and have advantages in efficiency and environmental emissions. Up to recently, all GCC plants have incorporated cold gas cleanup (i.e., water scrubbing) for control of char particulate (dust) entrained out of the gasifier with the raw product gas. All current GCC plant designs for entrained-flow and fluidized-bed gasifiers, however, incorporate hot gas filtration for capture of the gasifier dust. Benefits to be derived from hot gas dust filtration in GCC plants are as follows: (1) Enables use of lower cost downstream heat exchangers – smaller boiler, superheater (reduced fouling/improved heat transfer) – use of fire-tube (vs. water-wall) design – use of horizontal heat exchangers; (2) Increases reliability/availability of downstream heat exchangers – reduced erosion/corrosion – reduced solids deposits; (3) Improves process efficiency for two-stage entrained-flow gasifiers (e.g., Destec, CE, NEDO/IGC) – recycle dry (vs. wet) char to gasifier improve carbon conversion – reduces pressure drop for dust capture (vs. cyclones/scrubbers); and (4) Downstream wastewater cleanup simplified, i.e., wastewater does not contain fines.

5342 (DOE/METC/C–93/7046) **Ninth annual coal-fueled heat engines, advanced pressurized fluidized bed combustion, and gas stream cleanup systems contractors review meeting: Welcoming address.** Salvador, L.A. USDOE Morgantown Energy Technology Center, WV (United States). [1992]. 18p. Sponsored by USDOE, Washington, DC (United States). (CONF-921034–6: US Department of Energy contractors review meeting on coal-fueled heat engines, advanced PFBC and gas stream cleanup systems, Morgantown, WV (United States), 27-28 Oct 1992). Order Number DE93003199. Source: OSTI; NTIS; INIS; GPO Dep.

The market for retrofit and new capacity in the electric utility is expected to be very large: 250 gigawatt (GW) and 500 GW by the year 2030–an amount which equals the presently installed capacity in the US Overseas, the market is even larger! This large market will be driven by a number of key "drivers." In order for power generation systems to compete in this market, they will have to satisfy the market drivers. This will lead us inevitably to modular, low cost, super clean, efficient, and reliable products which are fuel flexible and can meet either retrofit, repowering, or new capacity applications. I believe clean coal technologies that we are developing will meet these market demands and will penetrate–and eventually dominate–the power generation market of the next century. But for this market penetration and widespread deployment to take place, the products we are jointly developing must be continuously improved. We must together set our goals on a rapid march down the learning curve from the present high "projected costs" of these systems to an acceptable market clearing price on the order of $1000 to $1200 per kilowatt (kw) and with heat rates approaching 7500 Btu per kilowatt-hour (kWh). The projected learning curve for integrated gasification combined cycle systems is a good illustration of the aggressive goals we need to achieve.

5343 (DOE/PC/90098–T7) **Predictive modelling of boiler fouling: Quarterly technical progress report, April 1, 1992–June 30, 1992.** Textron, Inc., Everett, MA (United States). Textron Defense Systems. [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-90PC90098. Order Number DE93004938. Source: OSTI; NTIS; GPO Dep.

As this study incorporates in a general framework, appropriate modules to model condensable species transport to the surface along with particles, the need for a suitable solver for the reaction component of the species equations with regard to issues of stability, stiffness, economy, etc. becomes obvious. It is generally agreed in the literature that the major problem associated with the simultaneous integration of large sets of chemical kinetic rate equations is that of stiffness. Although stiffness does not have a simple definition, it is characterized by widely varying time constants. For example, in hydrogen-air combustion, the induction time is of the order of microseconds whereas the nitric oxide formation time is of

the order of milliseconds. These widely different time constants present classical methods (such as the popular explicit Runge-Kutta method) with the following difficulty: to ensure stability of the numerical solution, these methods are restricted to using very short time steps that are determined by the smallest time constant. However, the time for all chemical species to reach near-equilibrium values is determined by the longest time constant. As a result, classical methods require excessive amounts of computer time to solve stiff systems of ordinary differential equations (ODE's). Several approaches for the solution of stiff ODE's have been proposed. Of all these techniques, the general purpose codes EPISODE and LSODE are regarded as the best available "packaged" codes for the solution of stiff systems of ODE'S. However, although these codes may be the best available for solving an arbitrary systems ODE'S, it may be possible to construct superior methods for solving a particular system of ODE's governing the behavior of a specific problem. In this view, an exponentially fitted method, CREK1D, deserves a special mention and is described briefly.

5344 (DOE/PC/90098–T8) **Predictive modelling of boiler fouling: Quarterly technical progress report, January 1, 1992–March 31, 1992.** Textron, Inc., Everett, MA (United States). Textron Defense Systems. [1992]. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-90PC90098. Order Number DE93004937. Source: OSTI; NTIS; GPO Dep.

In this reporting period, efforts were initiated to supplement the comprehensive flow field description obtained from the RNG-Spectral Element Simulations by incorporating, in a general framework, appropriate modules to model particle and condensable species transport to the surface. Specifically, a brief survey of the literature revealed the following possible mechanisms for transporting different ash constituents from the host gas to boiler tubes as deserving prominence in building the overall comprehensive model: (1) Flame-volatilized species, chiefly sulfates, are deposited on cooled boiler tubes via the mechanism of classical vapor diffusion. This mechanism is more efficient than the particulate ash deposition, and as a result there is usually an enrichment of condensable salts, chiefly sulfates, in boiler deposits; (2) Particle diffusion (Brownian motion) may account for deposition of some fine particles below 0. 1 mm in diameter in comparison with the mechanism of vapor diffusion and particle depositions, however, the amount of material transported to the tubes via this route is probably small. (3) Eddy diffusion, thermophoretic and electrophoretic deposition mechanisms are likely to have a marked influence in transporting 0.1 to 5μm particles from the host gas to cooled boiler tubes; (4) Inertial impaction is the dominant mechanism in transporting particles above 5μm in diameter to water and steam tubes in pulverized coal fired boiler, where the typical flue gas velocity is between 10 to 25 m/s. Particles above 10μm usually have kinetic energies in excess of what can be dissipated at impact (in the absence of molten sulfate or viscous slag deposit), resulting in their entrainment in the host gas.

5345 (DOE/PC/91155–T1) **Coal-fired high performance power generating system: Quarterly progress report.** United Technologies Research Center, East Hartford, CT (United States). 1 Jul 1992. 140p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-92PC91155. Order Number DE93004952. Source: OSTI; NTIS; GPO Dep.

The goals of the program are to develop a coal-fired high performance power generation system (HIPPS) by the year 2000 that is capable of > 47% thermal efficiency; NO_x SO_x and Particulates < 25% NSPS; Cost of electricity 10% lower; coal > 65% of heat input and all solid wastes benign. In order to achieve these goals our team has outlined a research plan based on an optimized analysis of a 250 MW_e combined cycle system applicable to both frame type and aeroderivative gas turbines. Under the constraints of the cycle analysis we have designed a high temperature advanced furnace (HITAF) which integrates several combustor and air heater designs with appropriate ash management procedures. Most of this report discusses the details of work on these components, and the R&D Plan for future work. The discussion of the combustor designs illustrates how detailed modeling can be an effective tool to estimate NO_x production, minimum burnout lengths, combustion temperatures and even particulate impact on the combustor walls. When our model is applied to the long flame concept it indicates that fuel bound nitrogen will limit the range of coals that can use this approach. For high nitrogen coals a rapid mixing, rich-lean, deep staging combustor will be necessary. The air heater design has evolved into two segments: a convective heat exchanger downstream of the combustion process; a radiant panel heat exchanger, located in the combustor walls; The relative amount of heat transferred either radiatively or convectively will depend on the combustor type and the ash properties.

5346 (ENEL-CRTN-T6–91-13) **Cycle chemistry monitoring in supercritical once-through power plants with AVT and CWT conditioning.** Barbato, F.; Quadri, G.; Scalari, G.; Sigon, F.; Zagano, C. Ente Nazionale per l'Energia Elettrica, Milan (Italy). Centro Termica e Nucleare. 1991. 39p. (CONF-9106189–2: International conference on fossil plant cycle chemistry, Baltimore, MD (United States), 4-6 Jun 1991). Order Number DE93748436. Source: OSTI; NTIS (US Sales Only).

The results of extensive cycle chemistry monitoring campaigns of ENEL (Italian Electricity Board) at Porto Tolle 4 and Porto Tolle 2 fossil fuel power plant are reported. The information acquired allows a detailed description of the chemistry through the cycle and a comparison of different water chemistries (AVT-P04 and CWT-P02) in once-through supercritical boilers. The feasibility of controlling cycle chemistry parameters within the limits suggested by the boiler manufacturer and the new EPRI Iterim Consensus Guidelines was confirmed for the AVT (All Volatile Treatment) conditioning. For CWT (Combined Water Treatment) data were compared for the VGB (German specifications) limits for similar boilers. The values and trends reported for the most significant chemical parameters, measured through the cycle, indicate that, by changing from AVT to CWT, a significant reduction of the oxides generation and transport to the boiler is achieved, as expected. Furthermore, the cycle chemistry appears reasonably fair or even better than that with AVT.

5347 (ETDE-IT–92-102) **Thermohydraulic process control systems: Design tools.** Bolis, V.; Quatela, S.; Zizzo, A. Ente Nazionale per l'Energia Elettrica, Milan (Italy). 1991. 22p. (In Italian). Order Number DE93748423. Source: OSTI; NTIS (US Sales Only).

Over the years, design tools have become increasingly sophisticated. It is now possible to use modular design codes to reproduce, with fairly good accuracy, the static and dynamic behaviour of thermohydraulic processes to allow the optimum design of suitable control systems. However, especially in the event that the structure of the proposed control system has not been established 'a priori', simplified models can play an important role by allowing designers to approximate, in analytical form, the most important characteristics of the system and thus obtain and interpret essential design information regarding the required control system. This paper illustrates how these simplified models can be integrated with more complete models in the design of systems for the control of the start-up of a fossil fuel power plant's cylindrical bodied boiler and the control of a heat exchanger's outlet temperature.

5348 (ETDE-IT–92-103) **Cylindrical-bodied 320 MWe boiler start-up performance model.** Beato, A.; Colombo, P.; Marziali, F.; Piroddi, L.; Quatela, S.; Zizzo, A. Ente Nazionale per l'Energia Elettrica, Milan (Italy); Ente Nazionale per l'Energia Elettrica, Rome (Italy). 1991. 13p. (In Italian). Order Number DE93748424. Source: OSTI; NTIS (US Sales Only).

Computer assisted design studies of the dynamic behaviour of new thermoelectric units are necessary in order to verify the impact of modifications to past designs. These design checks are done with the aim of verifying the effect of the modifications on process dynamics, as well as, on control system configurations and operating procedures. This paper describes the design check of a new poly-fuel 320 MWe cylindrical-bodied boiler for an ENEL (Italian Electricity Board) power plant located in Sardinia. This boiler design differs from past designs in that it adopts a system of start-up valves in order to make start-up operations after night-time shutdown more flexible and eliminate dynamic thermal stresses, associated with start-up, on the turbine rotors. With the use of a suitable mathematical model, simulations were done of boiler and

control system behaviour during start-up. This paper describes the code's implementation and the results obtained.

5349 (ETDE-mf–93744410) **Development of pressurized fluidized-bed combustion (PFBC) technology for coal-fired combined cycles. Final report.** Terhaag, U.; Verweyen, N.; Goermar, H.; Bu Cheng; Ewes, I.; Braun, A. Technische Hochschule Aachen (Germany). Lehrstuhl fuer Waermeuebertragung und Klimatechnik; Bundesministerium fuer Forschung und Technologie, Bonn (Germany); Steinmueller (L.u.C.) GmbH, Gummersbach (Germany). Jun 1992 139p. (In German). Contract BMFT 0326702B. Order Number DE93744410. Source: OSTI; NTIS (US Sales Only).

Pressurized fluidized combustion is a very essential component for combined cycles with low emissions and high efficiency. The aim of this project was further development of the stationary pressurized fluidized bed combustion technique. In the last two heating periods, a series of experiments was carried out with modifications of the combustion chamber. The results of these runs were compared with numerical simulations. Improved numerical procedures were used to develop a new design of the pressurized combustion chamber. Attention is focused on emission control for the components CO, NO_x and N_2O. The necessary modifications, however, result in an increase of the prognosted construction costs, so that the project was finished by the end of 1991. (orig.) With 15 refs., 2 tabs., 120 figs.

5350 (IA–1471, pp. 24) **Dynamic steam-generator model for general power plant application with DSNP.** Shapira, M.; Saphier, D.; Gal, D. Israel Atomic Energy Commission, Tel Aviv (Israel). Aug 1992. In *Research laboratories annual report 1991.* [247] Order Number DE93609217. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. STEAM GENERATORS/computerized simulation

5351 (NEI-FI–175) **Plastic wastes as support fuel.** Kaehrae, V. Association of Finnish Plastics Industry, Helsinki (Finland). 1991. 55p. (In Finnish). Order Number DE93752936. Source: OSTI; NTIS.

The association of Finnish Plastics Industry examined the possibilities to utilize energy content of plastic wastes in spring 1990. A bark fuelled boiler plant of forest industry was used as test power plant. The power of the plant was 60 Mw. This report discusses shortly the theory of combustion of plastics. About 130 000-15 000 tons of plastic waste, corresponding to 7 % of the solid municipal waste, is dumped annually in Finland. Utilization of the plastic waste recovered from municipal wastes for energy production is technically viable in present power plants among present energy production. The chipping and mixing of the plastic in the other fuel are the only pretreatment required for the plastic waste. In Finland there are several power plants using suitable fuels for plastic mixture combustion. The portion of the plastic of the total fuel power was 10 %. No problems occurred during the tests. The results of the tests are presented in this report. Special attention has been paid to emissions of harmful compounds, e.g. PAHs, HCl, chlorophenols, chlorinated dibenzofuranes and dibenzodioxines and particulates. According to the tests the plastic wastes can very easily be used for energy production.

5352 (TKK-S/SM–1989/21, pp. 21-26) **About efficiency of power system state minimax optimization.** Liik, O. (Tallinn Technical Univ. (Estonia). Power Systems Cybernetics Lab.). Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Electromechanics. 1989. (CONF-8901144–: Symposium on electrical power engineering at the Helsinki University of Technology, Espoo (Finland), 27 Jan 1989). In *Symposium on electrical power engineering.* 130p. Order Number DE93711132. Source: OSTI; NTIS.

The problem of optimal scheduling of active power generation in electric power system under the uncertainty of initial data is treated in the paper. The methods of power system state minimax optimization are described and the results concerning the efficiency analysis of these methods are given.

5353 (TKK-S/SM–1989/21, pp. 92-108) **Steady state analysis of synchronous machines by finite elements.** Keskinen, E. Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Electromechanics. 1989. (CONF-8901144–: Symposium on electrical power engineering at the Helsinki University of Technology, Espoo (Finland), 27 Jan 1989). In *Symposium on electrical power engineering.* 130p. Order Number DE93711132. Source: OSTI; NTIS.

The steady state operation of a synchronous machine is determined by solving the steady state voltage equations of the vector model together with the finite element solution of the field equation. The magnetic field is assumed to be uniform in the axial direction of the machine. The end-region fields are taken into account by constant end-winding inductances in the circuit equations. The saturated values of the basic inductances are determined by applying the superposition principle of flutes. The good correspondence of measured and calculated results seems to prove that the calculation method used, describes quite well the steady state operation of synchronous machines.

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Refer also to citation(s) 4861, 4863, 4864, 4867, 4931, 4944, 4947, 4954, 5344, 5860, 5966

5354 (DOE/ER/81349–93/C0125) **Advanced lightweight ceramic candle filter module.** Zievers, J.F.; Eggerstedt, P. Industrial Filter and Pump Mfg. Co., Cicero, IL (United States). [1992]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER81349. (CONF-920951–39: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93000211. Source: OSTI; NTIS; GPO Dep.

To determine the economic effect of light weight ceramics, several sizes of filters were cost estimated for operation at 217.5 psi (15 bar) based on the use of all light weight ceramics (Fibro/Fibro) vs. the use of cooled alloy (RA300) tubesheets and silicon carbide candles (Alloy/SiC). A jet pulse delivery system was included in both estimates. The Fibro/Fibro system was estimated with the plenum design while the Alloy/SiC system was based on header/nozzle design. Battery limits were the filters and jet pulse delivery systems, Ex-works, with no main valves or dust removal systems. It was found that the cost of Fibro/Fibro components were consistently lower than the cost of the Alloy/SiC components; this comparison is illustrated in Figure 8.

5355 (DOE/FE/61680–H2) **Screening analysis of CO_2 utilization and fixation: Final report.** Johnson, H.E.; Vejtasa, S.A.; Pelline, J.E.; Biasca, F.E.; Simbeck, D.R.; Dickenson, R.L. SFA Pacific, Inc., Mountain View, CA (United States). Aug 1992. 138p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC01-88FE61680. Order Number DE93004313. Source: OSTI; NTIS; GPO Dep.

The debate continues regarding the potential of global climate change as a result of increasing concentrations of greenhouse gases within the Earth's atmosphere. Carbon dioxide emissions account for about 55% of these gases (excluding water vapor). The increased atmospheric CO_2 concentration is primarily attributed to combustion of fossil fuels in energy production and to deforestation. This report is a screening analysis which addresses the various traditional and potential advanced options for utilization and fixation of CO_2, primarily from coal-fired electrical power generation. This study's results indicate that power production via coal gasification combined cycle is the most effective and least expensive means currently available for reducing CO_2 emissions from coal-fired power generation. Advanced coal-fired fuel cells, which are currently available, may prove to be substantially less expensive control options if the technology meets research goals. The costs associated with pipeline transport of CO_2 to disposal or utilization sites are also presented. This work also includes an extensive examination of the potential for underground disposal of CO_2 in geologic structures by investigating injection into gas and oil fields, salt domes, and other porous structures. The most viable option considered in this study for CO_2 disposal is in abandoned natural gas reservoirs.

5356 (DOE/MC/23252–93/C0127) **Mechanical analysis of a cross flow filter.** Alvin, M.A.; Lippert, T.E.; Attaar, M.H.; McNerney, K.R. Westinghouse Electric Corp., Pittsburgh, PA (United States). Science and Technology Center. [1992]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-86MC23252. (CONF-920951–51: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93003484. Source: OSTI; NTIS; GPO Dep.

Material properties have also been generated at the Argonne National Laboratories which detail the fracture toughness, Weibull modulus, and critical flaw size for a specifically fabricated lot of P-100A alumina/mullite cross flow filters.(Singh, 1990) The critical flaw size within the P-100A matrix was estimated to be ~500 μ,m which includes both large interconnected pores, as well as potentially debonded areas along the mid-rib or gas channel seams. Critical flaws are generally considered as potential failure initiation sites within the ceramic matrix. In addition maximum filter element stress levels induced by the process system have been estimated at ANL through the use of finite element computer analyses. These efforts project that the highest stresses result within the flange region of the cross flow filter. As a result of these projections, efforts at Coors Ceramics were directed to improving the overall strength of the alumina/mullite material which is used for cross flow filter fabrication. The results of the efforts at Coors Ceramics provide a significant improvement in the hot strength of the P-100A alumina/mullite filter matrix. Westinghouse assessed the existing nondestructive evaluation (NDE) techniques in terms of identifying methods for detecting critical flaws within the cross flow filter body. To date viable, cost effective methods for detecting critical flaws within the P-100A alumina/mullite matrix, or along the mid-rib bonds or gas channel seams in the full-scale, porous ceramic cross flow filter element are not readily available. As an alternate approach, Westinghouse focused its attention on developing NDE techniques as inspection methods for evaluating the extent of bonding along the mid-rib bonds and gas channel seams which results during the various fabrication stages of the cross flow filter element.

5357 (DOE/MC/25034–93/C0096) **Thermal/chemical stability of ceramic cross flow filter materials.** Alvin, M.A.; Bahovchin, D.M.; Lippert, T.E.; Tressler, R.E.; McNerney, K.B. Westinghouse Electric Corp., Pittsburgh, PA (United States). Science and Technology Center. [1992]. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-88MC25034. (CONF-920951–16: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93002710. Source: OSTI; NTIS; GPO Dep.

Westinghouse has undertaken a two phase program to determine possible long-term, high temperature influence that advanced coal-based power system environments may have on the stability of the ceramic cross flow filter elements. During the past year, we have principally focused our efforts on developing an understanding of the stability of the alumina/mullite filter material at high temperature (i.e., 870, 980, and 1100°C) under oxidizing conditions which contain gas phase alkali species. The alumina/mullite cross flow liter material that has consistently been used throughout the flow-through gas phase alkali testing segment of this program, consists of mullite rods or needles that are embedded within an amorphous phase which contains corundum (Al_2O_3) and anorthite ($CaAl_2Si_2O_8$). Due to the rapid cooling rate that was used to produce the alumina/mullite filter disc material from high fire, the matrix consists of 59.6 wt% mullite, 30.5 wt% amorphous, 5.1 wt% anorthite, and 4.8 wt% alumina. The relatively low, as-fabricated, hot strength of this material (841±259 psi at 870°C) is a direct result of the high amorphous content which softens at temperatures of 870°C. Load versus deflection curves as a function of temperature indicate that this material is relatively brittle up to temperatures of 600°C. Both a loss of strength, as well as plastic deformation of the matrix occurs at ~700°C. If cross flow filters are manufactured from an alumina/mullite matrix that contains an ~30.5 wt% amorphous content, we suspect that the plastic nature of the glass phase could potentially serve as a substrate for fines collection during initial filter operation at 700°C. Similarly the plastic nature could potentially cause deformation of the liter under load.

5358 (DOE/MC/27259–93/C0094) **Standleg Moving Granular Bed Filter development program.** Newby, R.A.; Yang, W.C.; Smeltzer, E.E. Westinghouse Electric Corp., Pittsburgh, PA (United States). Science and Technology Center. [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-91MC27259. (CONF-920951–26: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93002711. Source: OSTI; NTIS; GPO Dep.

The design, fabrication, and installation of the cold flow test facility has been completed. The SMGBF test facility shown in Figure 2 consists of a solids feed hopper, a transparent test vessel, a screw conveyor, a 55-gal drum for solids storage, a dust feeder, a baghouse filter, and the associated instrumentation for flow and pressure control and measurement. The standleg is 11-in ID by 3-ft long, and also transparent to facilitate observation. The crushed acrylic particles of characteristics shown in Table 1 are used as the bed media. The bed particles were selected, by maintaining the particle size while reducing the particle density, to simulate the minimum fluidization velocity expected under high-temperature, high-pressure conditions. By maintaining the particle size, the bed effectively simulates the bed packing and voidage in the moving bed which is directly related to the efficiency of particulate removal and pressure drop characteristics. The test facility performed as designed and no particular difficulties were encountered. The baseline data on pressure profiles across the stationary and the moving granular beds were obtained for gas face velocities up to 6 ft/s, higher than the minimum fluidization velocity of the bed material (5 ft/s), and no visible fluidization was observed at the base of the standleg. This confirms the operational feasibility of the compact SMGBF design.

5359 (DOE/MC/27423–93/C0095) **Moving Granular Bed Filter Development Program.** Wilson, K.B.; Haas, J.C.; Eshelman, M.B. Combustion Power Co., Inc., Menlo Park, CA (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-90MC27423. (CONF-920951–25: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93002712. Source: OSTI; NTIS; GPO Dep.

The granular bed filter was developed through low pressure, high temperature (1600°F) testing in the late 1970's and early 1980's'. Collection efficiencies over 99% were obtained. In 1988, high pressure, high temperature testing was completed at New York University, Westbury, N.Y., utilizing a coal-fired pressurized, fluidized bed combustor. High particulate removal efficiencies were confirmed as it was shown that both New Source Performance Standards and turbine tolerance limits could be met. The early scale-up work of the granular bed filter indicated potential limitations due to size, cost, and mechanical complexity. These limitations were addressed in the present program by utilizing the information gained from the filter development up through the NYU test program to reassess the commercial approach. Two studies were chosen for developing conceptual designs and cost estimates of the commercial sized filters. One is the economic study of the 250 MWe, second generation pressurized fluidized bed combustion plant defined by Foster Wheeler. This plant originally included cross-flow filters for hot gas cleanup. The other plant under study is a 100 MWe, airblown KRW gasifier. A cross-flow inter was utilized for gas stream cleanup in this study also. Granular bed and ceramic candle filters were substituted for the cross-flow filters in both these plants, and the resulting cost of electricity (COE) is compared.

5360 (DOE/METC/C–93/7043) **Fluidized-bed filter for particulate cleanup.** Mei, J.S.; Yue, P.C. USDOE Morgantown Energy Technology Center, WV (United States). [1992]. 17p. Sponsored by USDOE, Washington, DC (United States). (CONF-921034–3: US Department of Energy contractors review meeting on coal-fueled heat engines, advanced PFBC and gas stream cleanup systems, Morgantown, WV (United States), 27-28 Oct 1992). Order Number DE93003197. Source: OSTI; NTIS; GPO Dep.

Successful development of advanced coal-fired power conversion systems often requires reliable and efficient gas-stream-cleanup devices that can remove particulate and gaseous pollutants from high temperature and high pressure gas streams. A novel filter concept for particulate cleanup has been developed at the Morgantown Energy Technology Center (METC). The filter consists of a fine screened surface immersed in a fluidized bed of granular material. As the gas stream passes through the fluidized bed, a layer of fine granular material is deposited and packed at the screen surface, which provides a natural filter to separate the fine particles from the gas stream. Since the filtering media is the granular material supplied by the fluidized bed, the filter is not subjected to blinding. Cleaning the filter (if necessary) is much easier than with a ceramic filter because the inflowing gas, not the cohesive forces, maintains the filter media at the screen surface. Therefore, the screensurface can be readily cleaned by momentarily interrupting the gas flow. A two-dimensional fluidized-bed filter cold model was designed, constructed, and operated to explore the feasibility of this novel concept.

5361 (DOE/PC/79798–T26) **The Edgewater Coolside process demonstration.** McCoy, D.C. (CONSOL, Inc., Pittsburgh, PA (United States)); Scandrol, R.O.; Statnick, R.M.; Stouffer, M.R.; Winschel, R.A.; Withum, J.A.; Wu, M.M.; Yoon, H. Babcock and Wilcox Co., Barberton, OH (United States). Boiler Div.; CONSOL, Inc., Pittsburgh, PA (United States). Feb 1992. 341p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-87PC79798. Order Number DE93001722. Source: OSTI; NTIS; GPO Dep.

The Edgewater Coolside process demonstration met the program objectives which were to determine Coolside SO_2 removal performance, establish short-term process operability, and evaluate the economics of the process versus a limestone wet scrubber. On a flue gas produced from the combustion of 3% sulfur coal, the Coolside process achieved 70% SO_2 removal using commercially-available hydrated lime as the sorbent. The operating conditions were Ca/S mol ratio 2.0, Na/Ca mol ratio 0.2, and 20°F approach to adiabatic saturation temperature (∇T). During tests using fresh plus recycle sorbent, the recycle sorbent exhibited significant capacity for additional SO_2 removal. The longest steady state operation was eleven days at nominally Ca/S = 2, Na/Ca = 0.22, ∇T = 20–22°F, and 70% SO_2 removal. The operability results achieved during the demonstration indicate that with the recommended process modifications, which are discussed in the Coolside process economic analysis, the process could be designed as a reliable system for utility application. Based on the demonstration program, the Coolside process capital cost for a hypothetical commercial installation was minimized. The optimization consisted of a single, large humidifier, no spare air compressor, no isolation dampers, and a 15 day on-site hydrated lime storage. The levelized costs of the Coolside and the wet limestone scrubbing processes were compared. The Coolside process is generally economically competitive with wet scrubbing for coals containing up to 2.5% sulfur and plants under 350 MWe. Site-specific factors such as plant capacity factor, SO_2 emission limit, remaining plant life, retrofit difficulty, and delivered sorbent cost affect the scrubber-Coolside process economic comparison.

5362 (DOE/PC/79924–T6) **Flue gas desulfurization by rotating beds: Final technical report.** Gardner, N.; Keyvani, M.; Coskundeniz, A. Case Western Reserve Univ., Cleveland, OH (United States). Dept. of Chemical Engineering. [1992]. 197p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-87PC79924. Order Number DE93004919. Source: OSTI; NTIS; GPO Dep.

The operating and mass transfer characteristics of rotating foam metal beds were studied to determine the potential for flue gas desulfurization. This is a final technical report on the work supported by DOE #FG22-87-PC79924. The report is divided into two sections, Part 1 deals primarily with the operating characteristics of rotating beds, and Part 2 covers the mass transfer characteristics of $S0_2$ absorption in water-lime slurries. Rotating foam metal beds are in essence packed towers operated in high gravitational fields. The foam metal bed is in the form of a cylindrical donut, or torus, and is rotated to produced the high centrifugal forces. The liquid phase enters the bed at the inner surface of the torus and is pulled by the field through the bed. Gas flows countercurrent to the liquid. The bed packing can have a very large specific surface areas and not flood. Possible benefits include much smaller height of a transfer unit resulting in smaller equipment and supporting structures, reduced solvent inventory, faster response with improved process control, reduced pressure drop, and shorter startup and shut-down times. This work is concerned broadly with the operating characteristics of rotating beds, the objectives being to (1) determine the pressure drop through the rotating bed; (2) determine the power required to operate the beds, (3) investigate the residence time distribution of the liquid phase in the beds; and (4) determine the mass transfer coefficients of $S0_2$ absorption. Three packings of differing specific surface areas were studied, with areas ranging from 656 to 2952 m_2/m_3. Liquid flow rates to 36 kg/s^*m_2, gas flow rate to 2.2 kg/s^*m_2, and gravitational fields to 300 g were covered in this study.

5363 (DOE/PC/89652–T8) **Demonstration of selective catalytic reduction (SCR) technology for the control of nitrogen oxide (NO_x) emissions from high-sulfur coal-fired boilers: Quarterly report No. 8, April–June, 1992.** Southern Co. Services, Inc., Birmingham, AL (United States). Aug 1992. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-90PC89652. Order Number DE93005988. Source: OSTI; NTIS; GPO Dep.

The objective of this project is to demonstrate and evaluate commercially available Selective Catalytic Reduction (SCR) catalysts from US, Japanese and European catalyst suppliers on a high-sulfur US coal-fired boiler. SCR is a post-combustion nitrogen oxide (NO_x) control technology that involves injecting ammonia into the flue gas generated from coal combustion in an electric utility boiler. The flue gas containing ammonia is then passed through a reactor that contains a specialized catalyst. In the presence of the catalyst, the ammonia reacts with NO_x to convert it to nitrogen and water vapor. Although SCR is widely practiced in Japan and Europe, there are numerous technical uncertainties associated with applying SCR to US coals. These uncertainties include: (1) potential catalyst deactivation due to poisoning by trace metal species present in US coals that are not present in other fuels. (2) performance of the technology and effects on the balance-of-plant equipment in the presence of high amounts of SO_2 and SO_3. (3) performance of a wide variety of SCR catalyst compositions, geometries and methods of manufacture under typical high-sulfur coal-fired utility operating conditions. These uncertainties will be explored by constructing a series of small-scale SCR reactors and simultaneously exposing different SCR catalysts to flue gas derived from the combustion of high sulfur U. S. coal.

5364 (DOE/PC/89768–T7) **Pulsed electron beam precharger: Technical progress report No. 5, September 1–November 30, 1990.** Finney, W.C. (ed.); Shelton, W.N. Florida State Univ., Tallahassee, FL (United States). Dept. of Physics. [1990]. 36p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-89PC89768. Order Number DE93006131. Source: OSTI; NTIS; GPO Dep.

Electrostatic collection of a high resistivity aerosol using the Electron Beam Precipitator (EBP) collecting section was demonstrated during this reporting period (Quarter Five). Collection efficiency experiments were designed to confirm and extend some of the work performed under the previous contract. The reason for doing this was to attempt to improve upon the collection efficiency of the precipitator alone when testing with a very high resistivity, moderate-to-high concentration dust load. From the collector shakedown runs, a set of suitable operational parameters were determined for the downstream electrostatic collecting sections of the Electron Beam Precipitator wind tunnel. These parameters, along with those for the MINACC electron beam, will generally be held constant while the numerous precharging parameters are varied to produce an optimum particle charge. The electrostatic collector experiments were part of a larger, comprehensive investigation on electron beam precharging of high resistivity aerosol particles performed during the period covered by Quarters Five, Six, and Seven. This body of work used the same experimental apparatus

and procedures and the experimental run period lasted nearly continuously for six months. A summary of the Quarter Five work is presented in the following paragraphs. Section II-A of TPR 5 contains a report on the continuing effort which was expended on the modification and upgrade of the pulsed power supply and the monitoring systems prior to the initiation of the electron beam precharging experimental work.

5365 (DOE/PC/89768–T8) **Pulsed electron beam precharger: Technical progress report No. 6, December 1, 1990–February 28, 1991.** Finney, W.C. (ed.); Shelton, W.N. Florida State Univ., Tallahassee, FL (United States). Dept. of Physics. [1991]. 52p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-89PC89768. Order Number DE93006132. Source: OSTI; NTIS; GPO Dep.

Electron beam precharging of a high resistivity aerosol was successfully performed under a range of experimental conditions during Quarter Six of the contract. The initial E-beam particle precharging experiments completed this term were designed to extend the efficiency of particle charging and collection using a fine, monodisperse aerosol at relatively large loadings in the FSU Electron Beam Precipitator wind tunnel. There are several reasons for doing this: (1) to re-establish a baseline performance criterion for comparison to other runs, (2) to test several recently upgraded or repaired subsystems, and (3) to improve upon the collection efficiency of the electron beam precipitator when testing precharging effectiveness with a very high resistivity, moderate-to-high dust concentration. In addition, these shakedown runs were used to determine a set of suitable operational parameters for the wind tunnel, the electrostatic collecting sections, and the MINACC E-beam accelerator. These parameters will normally be held constant while the precharging parameters are varied to produce an optimum particle charge. The electron beam precharging investigation performed during the period covered by Quarter Six used virtually the same experimental apparatus and procedures as in previous contract work, and these are described for review in this report. This investigation was part of an experimental effort which ran nearly continuously for nine months, encompassing work on the electrostatic collecting section, electron beam precharger, and particle charge-to-radius measuring apparatus. A summary of the work on dc electron beam precipitation is presented here.

5366 (DOE/PC/89768–T9) **Pulsed electron beam precharger: Technical progress report No. 7, March 1–May 31, 1991.** Finney, W.C. (ed.); Shelton, W.N. Florida State Univ., Tallahassee, FL (United States). Dept. of Physics. [1991]. 47p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-89PC89768. Order Number DE93006133. Source: OSTI; NTIS; GPO Dep.

During the previous reporting period (Quarter Six), the charging and removal of a fine, high resistivity aerosol using the advanced technology of electron beam precipitation was successfully accomplished. Precharging a dust stream circulating through the EBP wind tunnel produced collection efficiency figures of up to 40 times greater than with corona charging and collection alone (Table 1). The increased system collection efficiency attributed to electron beam precharging was determined to be the result of increased particle charge. It was found that as precharger electric field was raised, collection efficiency became greater. In sequence, saturation particle charge varies with the precharger electric field strength, particle migration velocity varies with the precharger and collector electric field, and collection efficiency varies with the migration velocity. Maximizing the system collection efficiency requires both a high charging electric field (provided by the E-beam precharger), and a high collecting electric field (provided by the collector wires and plates). Because increased particle collection efficiency is directly attributable to higher particle charge, the focus of research during Quarter Seven was shifted to learning more about the actual charge magnitude on the aerosol particles. Charge determinations in precipitators have traditionally been made on bulk dust samples collected from the flue gas stream, which gives an overall charge vs. mass (Q/M) ratio measurement. More recently, techniques have been developed which allow the measurement of the charge on individual particles in a rapid and repeatable fashion. One such advanced technique has been developed at FSU for use in characterizing the electron beam precharger.

5367 (DOE/PC/89768–T10) **Pulsed electron beam precharger: Technical progress report No. 8, June 1, 1991–August 31, 1991.** Finney, W.C. (ed.); Shelton, W.N. Florida State Univ., Tallahassee, FL (United States). Dept. of Physics. [1991]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-89PC89768. Order Number DE93006134. Source: OSTI; NTIS; GPO Dep.

Quarter Eight of the Pulsed Electron Precharging project was principally devoted to the operation of the E-beam precharger in the pulsed anode mode. We shall first briefly review the motivation for carrying out this project and the experimental approach used. The combustion of low sulfur coal for the purpose of generating electric energy in power plants results in the production of a flue gas containing very high resistivity fly ash. This fly ash is not easily collected by conventional electrostatic precipitators due to the large electric potential difference which develops across the layer of fly ash on the collector plate. If this layer of collected material is allowed to reach a thickness as great as is normally desirable before "rapping" the plates, then the collected fly ash is subject to re-entrainment into the flue gas stream due to back-corona. The back-corona corona problem is described more fully in the next section of this report. This re-entrainment problem can be eliminated through reduction of the voltage applied across the high voltage wires and the grounded plates of the electrostatic precipitator. This is not a good solution to the problem since the charging capability and collection efficiency of the precipitator system are both greatly reduced at the low voltages required to avoid the back-corona problem. Another approach to solving the problems inherent in collecting high resistivity fly ash in an electrostatic precipitator is to decouple the charging and collecting functions. At FSU an electron beam precharger is employed directly before (upstream in the flue gas pathway) the precipitator. This precharger can be optimized for the charging function while the downstream collector can be optimized for collection of the high-resistivity fly ash.

5368 (DOE/PC/89768–T11) **Pulsed electron beam precharger: Technical progress report No. 9, September 1, 1991–November 30, 1991.** Finney, W.C. (ed.); Shelton, W.N. Florida State Univ., Tallahassee, FL (United States). Dept. of Physics. [1991]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-89PC89768. Order Number DE93006135. Source: OSTI; NTIS; GPO Dep.

Quarter Nine of the Pulsed Electron Precharging project was principally devoted to reviewing and interpreting the experimental results obtained during the past eight quarters of the project. We shall first briefly review the motivation for carrying out this project and the experimental approach used. The combustion of low sulfur coal for the purpose of generating electric energy in power plants results in the production of a flue gas containing very high resistivity fly ash. This fly ash is not easily collected by conventional electrostatic precipitators due to the large electric potential difference which develops across the layer of fly ash on the collector plate. If this layer of collected material is allowed to reach a thickness as great as is nominally desirable before "rapping" the plates, then the collected fly ash is subject to re-entrainment into the flue gas stream due to back-corona. The back-corona corona problem is described more fully in the next section of this report. This re-entrainment problem can be eliminated through reduction of the voltage applied across the high voltage wires and the grounded plates of the electrostatic precipitator. This is not a good solution to the problem since the charging capability and collection efficiency of the precipitator system are both greatly reduced at the low voltages and resultant small corona currents required to avoid the back-corona problem. Another approach to solving the problems inherent in collecting high resistivity fly ash in an electrostatic precipitator is to decouple the charging and collecting functions. At FSU an electron beam precharger is employed directly before (upstream in the flue gas pathway) the precipitator.

5369 (DOE/PC/89768–T12) **Pulsed electron beam precharger: Technical progress report No. 10, December 1, 1991–February 29, 1992.** Finney, W.C. (ed.); Shelton, W.N. Florida State Univ., Tallahassee, FL (United States). Dept. of

Physics. [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-89PC89768. Order Number DE93006136. Source: OSTI; NTIS; GPO Dep.

We shall first briefly review the motivation for carrying out this project and the experimental approach used. The combustion of low sulfur coal for the purpose of generating electric energy in power plants results in the production of a flue gas containing very high resistivity fly ash. This fly ash is not easily collected by conventional electrostatic precipitators due to the large electric potential difference which develops across the layer of fly ash on the collector plate. If this layer of collected material is allowed to reach a thickness as great as is normally desirable before "rapping" the plates, then the collected fly ash is subject to re-entrainment into the flue gas stream due to back-corona. The back-corona corona problem is described more fully in the next section of this report. This re-entrainment problem can be eliminated through reduction of the voltage applied across the high voltage wires and the grounded plates of the electrostatic precipitator. This is not a good solution to the problem since the charging capability and collection efficiency of the precipitator system are both greatly reduced at the low voltages required to avoid the back-corona problem. Another approach to solving the problems inherent in collecting high resistivity fly ash in an electrostatic precipitator is to decouple the charging and collecting functions. At FSU an electron beam precharger is employed directly before (upstream in the flue gas pathway) the precipitator. This precharger can be optimized for the charging function while the downstream collector can be optimized for collection of the high-resistivity fly ash. The characteristics of the Mk. III electron beam precharger have been investigated in a prior phase of this research.

5370 (DOE/PC/92151–T1) **[Industrial pulverized coal low NO_x burner, Phase I] technical progress report, April 1, 1992–June 30, 1992.** Little (Arthur D.), Inc., Cambridge, MA (United States). 1 Sep 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-92PC92151. Order Number DE93004953. Source: OSTI; NTIS; GPO Dep.

Market evaluation of industrial pulverized coal usage, and of typical industries and applications where the low-NO_x, burner may be sold, was partially completed at the end of this reporting period. The study identified three coals that may adequately meet the requirements of the low-NO_x burner modeling study, and of the intended industrial applications. These were: (a) Pittsburgh Seam Bituminous, (b) Pittsburgh No. 8, and (c) Utah Bituminous. The first burner design, for modeling studies, was developed for a nominal output of 5.0 million Btu/hr. All input and process parameters, and all major dimensions of the burner have been determined. Burner design sketch was developed. Standard jet pump geometry of the fuel-rich burner flow path (US Patents No. 4,445,842 and No. 3,990,831), has been modified for use with pulverized coal. Staged air was added. Staged air, in conjunction with recirculated flue gas, has been found by ADL, MIT and other researchers to be effective in NO_x, reduction. No attempt has been made to achieve compactness of design. The primary and seconder, air inlets and flow passages are separate, although in the industrial burner they will be combined. Flue gas may be drawn into the burner either from the hot furnace chamber, or from the flue stack after recuperation. However, to satisfy the energy requirements for volatilizing the coal, flue gas temperature above 2000°F may be needed. With the preliminary burner design completed, and suitable coals for the modeling study selected, type project is ready to proceed to the kinetic modeling tasks at MIT.

5371 (DTH-LBM-TR–91-250) **Fly-ash concrete: Strength and chloride penetration.** Moeller, E.B. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Bygningsmaterialer. Dec 1991. 167p. (In Danish). Order Number DE93752746. Source: OSTI; NTIS.

Various characteristics of fly-ash concrete were investigated and clarified in relation to the physical and chemical influence fly ash has when it is mixed into concrete. Forms of corrosion in reinforced concrete constructions are described, especially with regard to the measurement of chloride penetration. On the basis of experiments on pressure strength, the strength-development of this form of concrete was examined. Mathematical models for calculating strength development were tested. Chloride penetration was investigated in test samples which had lain in salt water solutions for four years. On the basis of these tests, calculations were made on the prospective lifetime of concrete constructions wherein chloride penetration was found. Here stricter demands on the thickness of concrete covers exposed to aggressive environments are recommended. This would triple the lifetime of concrete constructions, it is claimed. A control of the measuring method for determining the extent of chloride penetration was carried out. The significance of heat cracks in concrete was examined in relation to corrosion connected to reinforcement. Some of the samples that had lain in salt water for more than four years showed no sign of corrosion of the iron used for reinforcing the concrete. But when they were subjected to a temperature shock of 80 degrees centigrade, from hot to cold water, thermal cracks were induced on the surface of the samples. It was seen that the chloride had found a way through these cracks in towards the iron used for reinforcement. Measurement results are presented. (AB).

5372 (ENEL-CRTN-T6–91-05) **Nitrous oxide adsorption on DeNOx-ing catalysts.** Ramis, G.; Busca, G.; Bregani, F. Genoa Univ. (Italy). Ist. di Chimica Generale; Ente Nazionale per l'Energia Elettrica, Milan (Italy). Centro Termica e Nucleare. 1991. 27p. Order Number DE93748425. Source: OSTI; NTIS (US Sales Only).

The adsorption of N_20 in the temperature range 150-650 degrees K was investigated over model active and deactivated deNO-ing catalysts. Powders having the compositions TiO_2, V/TiO_2, W/TiO_2, $K\text{-}V/TiO_2$ and $K\text{-}W/TiO_2$ were taken into account. Molecular adsorption by coordination over surface cations through both the N- and the 0- end of the N_2O molecule was observed in all cases. The vibrational perturbation depends on the Lewis acid strength of the surface cations. These species are reversible at r.t. by short evacuation. Pre-adsorption of water and ammonia poisons the adsorption sites for N_2O, due to the much stronger basicity of these molecules. Evidence of the reaction of N_2O with adsorbed ammonia on V/TiO_2 is found only at 623 degrees K, unlike that for NO which oxidizes NH_3 starting already from 423 degrees K.

5373 (KFK-PEF–80-Vol.2, pp. 677-690) **Design of a periodically operated SCR reactor.** Kotter, M. (Inst. fuer Chemische Verfahrenstechnik, Karlsruhe Univ. (T.H.) (Germany)); Lintz, H.G.; Turek, T. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7. status colloquium of the PEF project on March 5-7, 1991 at Karlsruhe Nuclear Research Center.* 458p. Order Number DE93744819. Source: OSTI; NTIS (US Sales Only).

The use of the regenerative Ljungstrom heat exchanger of the power plant as a reactor for the selective catalytic reduction of nitrogren oxides represents a simple new process for the control of NO_x emissions. Two catalysts based on oxides of titanium, tungsten and vanadium have been developed to be used in the different temperature regions of the reactor. Thin layers of catalyst powder are placed on the heat exchanger elements. Activity and selectivity of the catalysts are quantified by rate measurements using a gradientless recirculation system. The measurements are carried out under technically relevant conditions with regard to the thickness of the catalyst layer and to the flue gas concentrations of oxygen and water. The calculated rates can be described with a simple equation. The developed catalysts exhibit a low activity for the undesired sulfur dioxide oxidation. The simulation of the instationary operation of the rotating heat exchanger demonstrates that the kinetic data determined under steady state conditions can be used to design the Ljungstrom SCR reactor. Furthermore it is shown that the problem of ammonia slippage can be solved by a modification of the new process: the addition of ammonia to the fresh air. (orig.).

5374 (KFK-PEF–80-Vol.2, pp. 691-702) **Selective catalytic reduction of nitrogen monoxide with ammonia under periodically changing reaction conditions using a zeolite catalyst.** Schoen, N. (Engler-Bunte-Inst. der Universitaet Karlsruhe (T.H.) (Germany). Bereich Gas, Erdoel und Kohle); Hedden, K.; Rao, B.R. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt

Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7. status colloquium of the PEF project on March 5-7, 1991 at Karlsruhe Nuclear Research Center.* 458p. Order Number DE93744819. Source: OSTI; NTIS (US Sales Only).

The development of the SCR-process operating under stationary conditions is one of the research efforts of the Engler-Bunte-Institute, Section Gas, Oil and Coal of the University Karlsruhe. By the periodical change of the flow direction of the gas and the addition of ammonia within a splitted catalyst zone the ammonia slip can be reduced considerably and a higher NO-conversion compared with the process operating under stationary conditions should be attained. From the results of the kinetics of the NO-reduction under stationary conditions and the measured NH_3-adsorption equilibrium on zeolite catalysts a calculation model was developed for the instationary operating process. The calculations show, that the above defined objectives can be achieved with the process variants suggested in this project. By computation a NO-conversion of 95% is attained by a catalyst loading of 2.13 cm^3/(gxs) at a temperature of 400deg C and a NO-concentration of 1,000 ppm whereby the ammonia slip is lower than 0.5 ppm. First experiments were carried out in a laboratory apparatus using a glas reactor. A zeolit catalyst with the active component HZSM-5 was used. The catalyst loading, the temperature, and the NO-concentration were 2.13 cm^3/(gxs), 400deg C, and ca. 530 ppm, respectively. The results show, that a NO-conversion of 99% and an ammonia slip of lower than 2 ppm is attained. (orig.).

5375 (KFK-PEF–80-Vol.2, pp. 703-714) **Simultaneous dry scrubbing of SO_2 and catalytic NO_x reduction using activated calcium based materials.** Weisweiler, W. (Inst. fuer Chemische Technik, Karlsruhe Univ. (T.H.) (Germany)); Schmitt, R.; Wendler, M. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7. status colloquium of the PEF project on March 5-7, 1991 at Karlsruhe Nuclear Research Center.* 458p. Order Number DE93744819. Source: OSTI; NTIS (US Sales Only).

The aim of the laboratory-scale experiments was found to be the development of a fluidized-bed process for the dry and simultaneous reduction of SO_2 and NO_x in flue gases. Both gaseous pollutants were now removed with yields above 95% operating between 300 and 450deg C. For desulfurisation, analoguous to the dry-additive process, pelletlike sorbents originating from a fluidized-bed calcined limestone and having a particle fraction around 500 μm were used in the laboratory. For example the maximum of the sorbent utilization rate reaches an amount of about 0.4 within a reaction time of 15 minutes. An activation with respect to a higher absorption capacity of CaO-pellets is possible by using melamine or urea. In the presence of CO_2 a certain amount of sorbent gets recarbonated. The formation of sulfite, normally one of the products in the desulfurisation process, is minimized in presence of NO_x and the SCR-catalyst. For denitrification according in the SCR-technique SiO_2-based catalysts of about 500 μm diameter and infiltrated by iron and manganese are mostly used. This type of environmentally acceptable SCR-catalyst is active in its oxide form at 200-300deg C, in its sulfatic form at 300-450deg C. The catalyst will be modified on the ambient conditions. (orig.).

5376 (ORNL/M–2347/V1) **Utility FGD survey: January–December 1989: Volume 1, Categorical summaries of FGD systems.** Hance, S.L.; McKibben, R.S.; Jones, F.M. Oak Ridge National Lab., TN (United States); IT Corp., Cincinnati, OH (United States). Mar 1992. 473p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93003683. Source: OSTI; NTIS; GPO Dep.

This is Volume 1 of the Utility flue gas desulfurization (FGD) Survey report, which is generated by a computerized data base management system, represents a survey of operational and planned domestic utility flue gas desulfurization (FGD) systems. It summarizes information contributed by the utility industry, system and equipment suppliers, system designers, research organizations, and regulatory agencies. The data cover system design, fuel characteristics, operating history, and actual system performance. Also included is a unit-by-unit discussion of problems and solutions associated with the boilers, scrubbers, and FGD systems. The development status (operational, under construction, or in the planning stages), system supplier, process, waste disposal practice, and regulatory class are tabulated alphabetically by utility company.

5377 (ORNL/M–2347/V2-Pt.1) **Utility FGD Survey, January–December 1989: Volume 2, Design performance data for operating FGD systems, Part 1.** Hance, S.L. (IT Corp., Cincinnati, OH (United States)); McKibben, R.S.; Jones, F.M. Oak Ridge National Lab., TN (United States); IT Corp., Cincinnati, OH (United States). Mar 1992. 713p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93003682. Source: OSTI; NTIS; GPO Dep.

The Utility flue gas desulfurization (FGD) Survey report, which is generated by a computerized data base management system, represents a survey of operational and planned domestic utility flue gas desulfurization (FGD) systems. It summarizes information contributed by the utility industry, system and equipment suppliers, system designers, research organizations, and regulatory agencies. The data cover system design, fuel characteristics, operating history, and actual system performance. Also included is a unit-by-unit discussion of problems and solutions associated with the boilers, scrubbers, and FGD systems. The development status (operational, under construction, or in the planning stages), system supplier, process, waste disposal practice, and regulatory class are tabulated alphabetically by utility company.

5378 (ORNL/M–2347/V2-Pt.2) **Utility FGD survey, January–December 1989: Volume 2, Design performance data for operating FGD systems: Part 2.** Hance, S.L. (IT Corp., Cincinnati, OH (United States)); McKibben, R.S.; Jones, F.M. Oak Ridge National Lab., TN (United States). Mar 1992. 722p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93003681. Source: OSTI; NTIS; GPO Dep.

This is Volume 2 part 2, of the Utility flue gas desulfurization (FGD) Survey report, which is generated by a computerized data base management system, represents a survey of operational and planned domestic utility flue gas desulfurization (FGD) systems. It summarizes information contributed by the utility industry, system and equipment suppliers, system designers, research organizations, and regulatory agencies. The data cover system design, fuel characteristics, operating history, and actual system performance. Also included is a unit-by-unit discussion of problems and solutions associated with the boilers, scrubbers, and FGD systems. This volume particularly contains basic design and performance data.

2005 Environmental Aspects

Refer also to citation(s) 5708, 6466

5379 (DOE/EA–0758) **Operating years 1993 through 1995 power purchases: Final environmental assessment.** USDOE Bonneville Power Administration, Portland, OR (United States). Dec 1991. 17p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93002269. Source: OSTI; NTIS; INIS; GPO Dep.

Bonneville Power Administration (BPA) is obligated to supply electric power to its contractual customers. Based on a forecast of growing customer loads and assuming Critical Period water conditions in the Columbia River Basin, BPA is planning to meet a firm energy deficit during the four operating years (OY) 1992 through 1995, i.e., August 1991 through July 1995. BPA has executed several power purchase agreements to cover the projected OY 1992 deficit. The proposed action is to extend two existing one-year power purchase agreements for an additional three years to cover the four-year Critical Period energy deficit. The extension of these two one-year power purchase agreements would: (1) increase BPA's firm energy load-carrying capability; (2) allow BPA to meet

its firm energy contractual commitments over the remaining three years of the four-year Critical Period from August 1, 1992, to July 31, 1995; (3) provide flexibility for BPA's use of hydroelectric resources over the Critical Period; and (4) increase system reliability. Under Critical Period water conditions, absent the proposed action, projected loads would exceed the capability of the Federal power system to serve those loads. The purpose of BPA's proposed action is to assure consistency with its statutory responsibilities, including those found in the Pacific Northwest Electric Power Planning and Conservation Act (Northwest Power Act).

5380 (NEI-FI–176) **The role of chlorine and additives of PVC-plastic in combustion.** Mattila, H. Kuopio Univ. (Finland). Faculty of Natural and Environmental Sciences; Association of Finnish Plastics Industry, Helsinki (Finland). 1991. 106p. (In Finnish). Order Number DE93752937. Source: OSTI; NTIS; INIS.

The PVC differs from other common plastics due to the chlorine content. As the PVC is combusted, the chlorine is released mainly as hydrogen chloride. The content of chlorinated hydrocarbons is small, but these can also contain polychlorinated dibenzofuranes and dibenzodioxines, which are extremely poisonous. The aim of this study was to find out, what is the portion of PVC combustion in total emission of chlorinated hydrocarbons. Additionally, the amounts chlorine coming into combustion process with ordinary fuels have been estimated, and they are compared with the amounts of PVC. The chloride content of municipal wastes vary in between 0.4-0.9 %. The portion of plastics is about 30 % of the total, and the rest being from paper, food , wood and garden wastes an textiles. Both organic and inorganic chlorine form gaseous hydrogen chlorid in combustion processes. HCl can then react with oxygen and produce caseous chlorine. This can react with unreacted carbon of the smoke and produce different kinds of chlorinated hydrocarbons. The portion of PVC of the chlorine going into combustion in Finland has been estimated to be about 1-2 %. Combustion tests were made using coal and bark and plastic waste as additional fuel. It was noticed that addition of plastic decreased the amount of polyaromatic hydrocarbons in the smoke. Chlorinated dioxins and furans occurred a little less in the gases of combustion of plastic mixtures not containing PVC than in reference tests, but they increased when PVC containing plastic mixture was combusted, but more chlorinated dioxins and furans were absorbed into fly ash, so the emissions remained almost the same.

2006 Economic, Industrial, and Business Aspects

Refer also to citation(s) 5379

2007 Legislation and Regulations

5381 (LIS–98) **Transferring the EC council directive on large-scale combustion plants into legislation of the member states.** Koch, E.; Altenbeck, P. Landesanstalt fuer Immissionsschutz des Landes Nordrhein-Westfalen, Essen (Germany); Ministerium fuer Umwelt, Raumordnung und Landwirtschaft des Landes Nordrhein-Westfalen, Duesseldorf (Germany). 1992. 118p. (In German). Order Number DE93742644. Source: OSTI; NTIS (US Sales Only).

The EC Council Directive of 1988 on the limitation of emissions of certain pollutants into the air from large combustion plants is to be transfered into legislation by the individual member states of the European Economic Community. In this paper, we compare the legislatory activities of the member states translating the EC Council Directive into national legislation as well as the practical aspects of regulations issued up to now for large combustion plants. The rules for confining emissions of new plants and the programs for confining emissions of existing plants are described in detail. Substantial differences exist between regulations in the individual member states, particularly when the rules for emission measurements are considered which are to be performed in the monitoring of new plants. The legislatory activities in a particular member state can be appreciated only by considering the total system of all regulations of this state in a comprehensive context. The paper also includes a discussion of the probable tendencies in the European Communities relating to further developments of the Council Directive, e.g. the tendencies of tightening emission standards are presented. Some hints are presented with regard to the practical realisation of the directive in the Federal Republic of Germany. (orig.).

21 NUCLEAR POWER REACTORS AND ASSOCIATED PLANTS

Refer also to citation(s) 5133, 5337, 5488

5382 (IAEA-TECDOC–665, pp. 103-110) **Physical metallurgy basis for broader and safe use of 13Cr-4Ni-0.5Mo steel in nuclear power engineering.** Vodarek, V. (Vitkovice Research Inst., Ostrava (Czechoslovakia)); Barta, J.; Tvrdy, M.; Motloch, Z. International Atomic Energy Agency, Vienna (Austria). Sep 1992. (CONF-9105343–: IAEA-Technical Committee meeting on materials for advanced water-cooled reactors, Plzen (Czechoslovakia), 14-17 May 1991). In *Materials for advanced water cooled reactors: Proceedings of a technical committee meeting held in Plzen Czechoslovakia, 14-17 May 1991.* [163] Order Number DE93609447. Source: OSTI; NTIS (US Sales Only); INIS.

VITKOVICE as one of the first companies exploited 15 years ago successfully the secondary metallurgy in the production of martensitic-austenitic 13Cr-4Ni-0.5Mo and 13Cr-6Ni-0.5Mo stainless steels of very low carbon content and the products in cast or wrought form exhibited excellent ductility and toughness in a wide range of testing temperatures. Noteworthy was the finding that such very low carbon grades are highly resistant against the temper embrittlement, even after prolonged tempering against the temper embrittlement, even after prolonged tempering at temperatures close to 500 deg. C. As a reason for such behaviour serves the presence of only small amount of carbides at the grain boundaries which leads to the elimination of one of conditions necessary to originate the intergranular fracture. Such controlled carbide-free microstructure of martensite and certain percentage of reversion austenite further performs high resistance to intergranular corrosion and other type of local corrosion events in high temperature water as well as the low susceptibility to hydrogen embrittlement. (author). 19 refs, 9 figs, 3 tabs.

5383 (IAEA-TECDOC–665, pp. 110-116) **The influence of cold plastic deformation and heat treatment on the mechanical properties of stainless steels.** Hajewska, E. (Institute of Atomic Energy, Otwock-Swierk (Poland)). International Atomic Energy Agency, Vienna (Austria). Sep 1992. (CONF-9105343–: IAEA-Technical Committee meeting on materials for advanced water-cooled reactors, Plzen (Czechoslovakia), 14-17 May 1991). In *Materials for advanced water cooled reactors: Proceedings of a technical committee meeting held in Plzen Czechoslovakia, 14-17 May 1991.* [163] Order Number DE93609447. Source: OSTI; NTIS (US Sales Only); INIS.

The mechanical properties of the material depend to a high degree from its structure, namely from the heat treatment and plastic processing, as well as from the exploitation conditions. The chrome-nickel stainless steels are used as a construction material for the equipment, such as the heat exchanger and the steam generators, and the pipelines of the primary circuits of the pressure water reactors. Generally they are used after solution heat treatment. In this state the stainless steels have a relatively homogeneous austenitic structure with the presence of minute amounts of high-temperature δ-ferrite. In the course of manufacture of the equipment the components are subjected to the welding processes, plastic working and heat treatment. Also during exploitation the material is subjected to the influence of high temperatures, thermal shocks, mechanical loads and variable stresses. All these factors exert many changes in the structure of the stainless steels, mainly caused by the precipitation processes. In this paper the results of the investigation of the stainless steels with various carbon content after different kind of heat treatment and cold plastic deformation there are described. The influence of these factors on the mechanical properties of the steels was also studied. (author). 4 refs, 12 figs, 2 tabs.

5384 (IAEA-TECDOC–665, pp. 151-155) **Some experience with nuclear materials.** Yadav, R.S.S. (Bhabha Atomic Research Centre, Bombay (India)); Mehra, V.K. International Atomic Energy

Agency, Vienna (Austria). Sep 1992. (CONF-9105343–: IAEA-Technical Committee meeting on materials for advanced water-cooled reactors, Plzen (Czechoslovakia), 14-17 May 1991). In *Materials for advanced water cooled reactors: Proceedings of a technical committee meeting held in Plzen Czechoslovakia, 14-17 May 1991.* [163] Order Number DE93609447. Source: OSTI; NTIS (US Sales Only); INIS.

Large-size forgings of the SA508C13 steel, and its qualification to the requirements of ASME B and PV code were studied. When heated with low Ni and high non-metallic inclusions, it resulted in large anisotropy and low impact values. The importance of having clean steel is emphasized. Accelerated corrosion tests on INCONEL-600 forgings with controlled carbon show that the resistance of components that are composed of it is not impaired when subjected to the stress relieving cycle. The development of a special bimetallic weld joint, which avoids stress relieving after butt-welding, is also discussed. (author). 2 refs, 8 tabs, 3 sketches.

2101 Power Reactors, Nonbreeding, Light-Water Moderated, Boiling Water Cooled

Refer also to citation(s) 5395, 5406, 5472, 5483, 5487, 5630, 5631, 5633, 5634, 5635, 5639, 5640, 5645, 5649, 5650, 5652, 5653, 5654, 5655, 5917

5385 (IAEA-TECDOC–665) **Materials for advanced water cooled reactors: Proceedings of a technical committee meeting held in Plzen Czechoslovakia, 14-17 May 1991.** International Atomic Energy Agency, Vienna (Austria). Sep 1992. [163] (CONF-9105343–: IAEA-Technical Committee meeting on materials for advanced water-cooled reactors, Plzen (Czechoslovakia), 14-17 May 1991). Order Number DE93609447. Source: OSTI; NTIS (US Sales Only); INIS.

The current IAEA programme in advanced nuclear power technology promotes technical information exchange between Member States with major development programmes. The International Working Group on Advanced Technologies for Water Cooled Reactors recommended to organize a Technical Committee Meeting for the purpose of providing an international forum for technical specialists to review and discuss aspects regarding development trends in material application for advanced water cooled reactors. The experience gained from the operation of current water cooled reactors, and results from related research and development programmes, should be the basis for future improvements of material properties and applications. This meeting enabled specialists to exchange knowledge about structural materials application in the nuclear island for the next generation of nuclear power plants. Refs, figs, tabs.

5386 (INIS-mf–14087) **KKB business report 1991.** Kernkraftwerk Brunsbuettel GmbH (Germany). 1992 16p. (In German). Order Number DE93744269. Source: OSTI; NTIS (US Sales Only); INIS.

A brief look at the most important events in the Brunsbuettel nuclear power station is followed by the presentation of the annual report 1991 of the company which operates the nuclear power station. It contains the necessary financial data such as balance, profit-and-loss account, etc. (UA).

5387 (NUREG–1433-Vol.3) **Standard Technical Specifications, General Electric plants, BWR/4: Volume 3, Bases (Sections 3.4-3.10).** Nuclear Regulatory Commission, Washington, DC (United States). Div. of Operational Events Assessment. Sep 1992. 409p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This NUREG contains improved Standard Technical Specifications (STS) for General Electric Plants, BWR/6, and documents the positions of the Nuclear Regulatory Commission based on the B&W Owners Group's proposed STS. This document is the result of extensive technical meetings and discussions among the NRC staff, the Nuclear Steam Supply System (NSSS) Owners Groups, the NSSS vendors, and the Nuclear Management and Resources Council (NUMARC). The improved STS were developed based on the criteria in the interim Commission Policy Statement on Technical Specification Improvements for Nuclear Power Reactors, dated February 6, 1987. The improved STS will be used as the basis for individual nuclear power plant licensees to develop improved plant-specific technical specifications. This report contains three volumes. Volume 1 contains the Specifications for all chapters and sections of the improved STS. Volume 2 contains the Bases for Chapters 2.0 and 3.0, and Sections 3.1–3.3 of the improved STS. This document Volume 3, contains the Bases for Sections 3.4–3.10 of the improved STS.

5388 (NUREG–1434-Vol.1) **Standard Technical Specifications, General Electric Plants, BWR/6: Volume 1, Specifications.** Nuclear Regulatory Commission, Washington, DC (United States). Div. of Operational Assessment. Sep 1992. 414p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This NUREG contains improved Standard Technical Specifications (STS) for General Electric Plants, BWR/6, and documents the positions of the Nuclear Regulatory Commission based on the B&W Owners Group's proposed STS. This document is the result of extensive technical meetings and discussions among the NRC staff, the Nuclear Steam Supply System (NSSS) Owners Groups, the NSSS vendors, and the Nuclear Management and Resources Council (NUMARC). The improved STS were developed based on the criteria in the interim Commission Policy Statement on Technical Specification Improvements for Nuclear Power Reactors, dated February 6, 1987. The improved STS will be used as the basis for individual nuclear power plant licensees to develop improved plant-specific technical specifications. This report contains three volumes. This document Volume 1, contains the Specifications for all chapters and sections of the improved STS. Volume 2 contains the Bases for Chapters 2.0 and 3.0, and Sections 3.1–3.3 of the improved STS. Volume 3 contains the Bases for Sections 3.4–3.10 of the improved STS.

5389 (NUREG–1434-Vol.2) **Standard Technical Specifications, General Electric plants, BWR/6: Volume 2, Bases (Sections 2.0-3.3).** Nuclear Regulatory Commission, Washington, DC (United States). Div. of Operational Events Assessment. Sep 1992. 331p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This NUREG contains improved Standard Technical Specifications (STS) for General Electric Plants, BWR/6, and documents the positions of the Nuclear Regulatory Commission based on the B&W Owners Group's proposed STS. This document is the result of extensive technical meetings and discussions among the NRC staff, the Nuclear Steam Supply System (NSSS) Owners Groups, the NSSS vendors, and the Nuclear Management and Resources Council (NUMARC). The improved STS were developed based on the criteria in the interim Commission Policy Statement on Technical Specification Improvements for Nuclear Power Reactors, dated February 6, 1987. The improved STS will be used as the basis for individual nuclear power plant licensees to develop improved plant-specific technical specifications. This report contains three volumes. Volume 1 contains the Specifications for all chapters and sections of the improved STS. This document Volume 2, contains the Bases for Chapters 2.0 and 3.0, and Sections 3.1–3.3 of the improved STS. Volume 3 contains the Bases for Sections 3.4–3.10 of the improved STS.

2102 Power Reactors, Nonbreeding, Light-Water Moderated, Nonboiling Water Cooled

Refer also to citation(s) 5385, 5472, 5482, 5483, 5615, 5625, 5629, 5630, 5631, 5632, 5633, 5637, 5640, 5641, 5642, 5643, 5644, 5646, 5648, 5652, 5653, 5654, 5655

5390 (CONF-9210209–2) **Experimental investigations of the fracture toughness enhancement associated with shallow flaws.** Theiss, T.J. (Oak Ridge National Lab., TN (United States)); Shum, D.K.M.; Rolfe, S.T. Oak Ridge National Lab., TN (United States). [1992]. 18p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. From OECD/IAEA/CSNI joint international specialists meeting on fracture mechanics verification by large scale

testing; Knoxville, TN (United States); 26-29 Oct 1992. Order Number DE93003100. Source: OSTI; NTIS; INIS; GPO Dep.

The Heavy Section Steel Technology Program (HSST) is investigating the influence of flaw depth on the fracture toughness of reactor pressure vessel (RPV) steel. Recently, it has been shown that shallow cracks tend to exhibit an elevated toughness as a result of a loss of constraint at the crack tip. The loss of constraint takes place when interaction occurs between the elastic-plastic crack-tip stress field and the specimen surface nearest the crack tip. An increased shadow-crack fracture toughness is of interest to the nuclear industry because probabilistic fracture-mechanics evaluations show that shallow flaws play a dominant role in the probability of vessel failure during postulated pressurized-thermal-shock (PTS) conditions. The HSST investigation is a joint analytical/experimental study combining the use of shallow-cracked laboratory specimens with RPV analysis. All tests have been performed on beam specimens loaded in 3-point bending using specimens about 100 mm deep. Primarily two crack depths have been considered: a = 50 and 9 mm (a/W = 0.5 and 0.1). Test results indicate a significant increase in the fracture toughness associated with the shallow flaw specimens in the lower transition region compared to the conventional fracture toughness. The testing has produced a limited database of fracture-toughness values as a function of crack depth which can be used in probabilistic or deterministic fracture mechanics analyses of pressure vessel integrity. Final test results from the shallow-crack fracture toughness program will be included in this paper. Examination of previously tested thermal shock data reveals that no toughness elevation appears to be present even though the thermal shock cylinders were tested with shallow flaws.

5391 (DOE/ER/12809–1) **The slightly-enriched spectral shift control reactor: Progress report, September 30, 1988–May 31, 1989.** Martin, W.R. (Michigan Univ., Ann Arbor, MI (United States). Dept. of Nuclear Engineering); Lee, J.C.; Edlund, M.C. Michigan Univ., Ann Arbor, MI (United States). Dept. of Nuclear Engineering. Jun 1989. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG07-88ER12809. Order Number DE92040986. Source: OSTI; NTIS; INIS; GPO Dep.

An advanced converter reactor design utilizing mechanical spectral shift control rods in a conventional pressurized water reactor configuration is under investigation. The design is based on the principle that a harder spectrum during the early part of the fuel cycle will result in larger neutron captures in fertile ^{238}U, which can then be burned in situ in a softer spectrum later in the cycle. Pre design calculations performed during F 89 show that the slightly-enriched spectral shift reactor design offers the benefit of substantially increased fuel resource utilization with the proven safety characteristics of the pressurized water reactor technology retained. Optimization of the fuel design and development of fuel management strategy will be carried out in FY 90, together with development and validation of neutronic methodology for tight-lattice configurations with harder spectrum. B&W Fuel Company will perform a detailed mechanical and thermal-hydraulic analysis of the spectral shift reactor design to ensure that it is a safe and viable design that could be implemented in a nuclear power plant under construction.

5392 (IAEA-TECDOC–665, pp. 19-27) **Advanced properties of structural materials for nuclear equipment in Eastern countries.** Brumovsky, M. (Skoda, Plzen (Czechoslovakia). Zavod Vystavba Jadernych Elektraren). International Atomic Energy Agency, Vienna (Austria). Sep 1992. (CONF-9105343–: IAEA-Technical Committee meeting on materials for advanced water-cooled reactors, Plzen (Czechoslovakia), 14-17 May 1991). In *Materials for advanced water cooled reactors: Proceedings of a technical committee meeting held in Plzen Czechoslovakia, 14-17 May 1991.* [163] Order Number DE93609447. Source: OSTI; NTIS (US Sales Only); INIS.

The paper gives a survey of material problems of key components of primary circuit of WWER (PWR) type of reactors as they arose during their development and operation. The paper also summarizes main parameters and material properties of these components together with research and development programmes that are in progress in this field in countries operating WWER type of reactors. (author). 2 refs, 6 figs, 8 tabs.

5393 (IAEA-TECDOC–665, pp. 71-77) **Materials in WWER reactor vessels.** Getmanchuk, A.V. (Experimental Design Bureau, Podol'sk (Russian Federation)); Dragunov, Yu.G. International Atomic Energy Agency, Vienna (Austria). Sep 1992. (CONF-9105343–: IAEA-Technical Committee meeting on materials for advanced water-cooled reactors, Plzen (Czechoslovakia), 14-17 May 1991). In *Materials for advanced water cooled reactors: Proceedings of a technical committee meeting held in Plzen Czechoslovakia, 14-17 May 1991.* [163] Order Number DE93609447. Source: OSTI; NTIS (US Sales Only); INIS.

An historical background of the development of WWER reactor materials, and of fabrication technologies, is given. Data are provided on specification requirements and mechanical properties of base materials, as well as on specific welding materials that are used in WEERs. This is followed by proposals of measures for extending the service life of reactor vessels being designed anew, and of vessels that are already in operation. (author). 2 figs, 3 tabs.

5394 (IAEA-TECDOC–665, pp. 77-97) **Investigation of irradiation embrittlement and recovery properties of pressure vessel steels of WWER reactors in the USSR.** Amaev, A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (Russian Federation). Inst. Atomnoj Ehnergii); Kryukov, A.; Levit, V.; Platonov, P.; Sokolov, M. International Atomic Energy Agency, Vienna (Austria). Sep 1992. (CONF-9105343–: IAEA-Technical Committee meeting on materials for advanced water-cooled reactors, Plzen (Czechoslovakia), 14-17 May 1991). In *Materials for advanced water cooled reactors: Proceedings of a technical committee meeting held in Plzen Czechoslovakia, 14-17 May 1991.* [163] Order Number DE93609447. Source: OSTI; NTIS (US Sales Only); INIS.

The paper presents the main results of a complex program on investigations of irradiation embrittlement of WWER-440 reactor vessel (RV) materials, carried out in the USSR. The object of investigations was surveillance specimens (SS) of RV materials. It has been found that at an irradiation temperature of 270 deg. C neither the base metal (steel 15 Kh2MFA) nor weld metal exhibit saturation of irradiation embrittlement (IE) in irradiation of specimens up to fluences of neutrons $7x10^{20}n/cm^2$. Regularities in the influence of impurity elements (copper and phosphorus) on IE of RV materials have been investigated. It is shown that IE of the weld metal is determined by at least four processes associated with the individual effects of copper and phosphorus, their joint effect and the mechanism of direct buildup of radiation defects in the metal. The effect of dependence of the IE characteristics of the WWER-440 RV materials on the neutron flux has been found. It is shown that within the range of fluences from 1 to $5x10^{19}n/cm^2$ at a neutron flux $4x10^{11}n/cm^2.s$ IE is stronger than in irradiation at a neutron flux $3\text{-}4x10^{12}n/cm^2.s$. A tendency has been observed for the values of the irradiation embrittlement coefficients A_F, characterizing sensitivity of the steel to IE, to reduce with increase of neutron fluence in irradiation of specimens with the neutron flux $4x10^{11}n/cm^2.s$. (author). 14 refs, 13 figs, 2 tabs.

5395 (IAEA-TECDOC–665, pp. 28-49) **Historical evolution in the field of materials for nuclear power plants with water cooled and moderated reactors in Western countries.** Tenckhoff, E. (Siemens AG, Erlangen (Germany)); Erve, M. International Atomic Energy Agency, Vienna (Austria). Sep 1992. (CONF-9105343–: IAEA-Technical Committee meeting on materials for advanced water-cooled reactors, Plzen (Czechoslovakia), 14-17 May 1991). In *Materials for advanced water cooled reactors: Proceedings of a technical committee meeting held in Plzen Czechoslovakia, 14-17 May 1991.* [163] Order Number DE93609447. Source: OSTI; NTIS (US Sales Only); INIS.

The steady long range development of the main materials used for the construction of primary components of commercially used pressurized water reactors and boiling water reactors in the western world is described. A review of long-term service record gained with operating materials shows that materials technology has attained a level which is a reliable basis for safety and structural integrity of components for advanced water cooled reactors, too. Additional optimization can be envisaged to further increase the safety margin between material loadability and component load. Special emphasis must be put on advanced safety and engineering

concepts, e.g. leak before break and break preclusion, Co-free primary circuit. (author). 29 refs, 19 figs, 4 tabs.

5396 (IAEA-TECDOC–665, pp. 101-102) **Progress in welding procedures for dissimilar metal welds of PWR primary systems.** Pichon, C. (Electricite de France, (EDF), 69 - Villeurbanne (France). Design Dept. for Thermal and Nuclear Projects); Dennielou, Y. International Atomic Energy Agency, Vienna (Austria). Sep 1992. (CONF-9105343–: IAEA-Technical Committee meeting on materials for advanced water-cooled reactors, Plzen (Czechoslovakia), 14-17 May 1991). In *Materials for advanced water cooled reactors: Proceedings of a technical committee meeting held in Plzen Czechoslovakia, 14-17 May 1991.* [163] Order Number DE93609447. Source: OSTI; NTIS (US Sales Only); INIS.

Various problems with dissimilar metal welds, although not compromising to unit safety, have led Electricite de France to make certain changes to their 1450 MWe PWR series. These include a change to the use of the nickel-based weld metal INCONEL, modifications in welding procedures, and investigations into inspection techniques. (author).

5397 (IAEA-TECDOC–665, pp. 122-130) **Improved PWR fuel cladding.** Sabol, G.P. (Westinghouse Commercial Nuclear Fuel Div., Pittsburgh, PA (United States)); Schoenberger, G.; Balfour, M.G. International Atomic Energy Agency, Vienna (Austria). Sep 1992. (CONF-9105343–: IAEA-Technical Committee meeting on materials for advanced water-cooled reactors, Plzen (Czechoslovakia), 14-17 May 1991). In *Materials for advanced water cooled reactors: Proceedings of a technical committee meeting held in Plzen Czechoslovakia, 14-17 May 1991.* [163] Order Number DE93609447. Source: OSTI; NTIS (US Sales Only); INIS.

Observations of irradiation-enhanced corrosion of PWR fuel at higher exposures has necessitated the development of improved cladding alloys through alloy modification of Zircaloy-4 within the specification limits, and through the formulation of alternate alloy compositions. The ZIRLO™ composition, Zr-1.0Nb-1.0Sn-0.1Fe, was developed as a superior corrosion resistant material for use in high-burnup fuel. The selection of alloying constituents and processing approach was based upon extensive laboratory data on the corrosion behavior of various Zr-Nb and Zr-Nb-Sn alloys, coupled with favorable data reported for Zr-2.5Nb, and the reported resistance to irradiation enhanced corrosion of a Zr-1Nb-1Sn-0.5Fe alloy in an oxygenated boiling water loop. Thus, fuel tubes of several Zr-Nb binary alloys containing up to 2.5% Nb, and of the ZIRLO composition, were fabricated with particular attention to achieving a fine size and uniform distribution of second phase particles. Fuel rods of these alloys were inserted into the BR-3 reactor and achieved rod average burnups of up to 71 GWD/MTU during four cycles of operation. ZIRLO cladding displayed corrosion improvement of up to 50%, lower creep, and lower growth than the Zircaloy-4 cladding. Nodular corrosion was observed on the 1.0 and 2.5 Nb binary alloys, but was not present on the ZIRLO rods. ZIRLO was selected as the preferred cladding for high-burnup fuel. The results of one-cycle exposure in demonstration assemblies in a high-rated commercial PWR confirm the improved corrosion resistance of ZIRLO over Zircaloy-4. A full region of ZIRLO-clad fuel is planned for insertion in another PWR later in 1991. (author). 15 refs, 13 figs, 1 tab.

5398 (IAEA-TECDOC–665, pp. 117-122) **Characterization of material properties for assessment of integrity and application of leak-before-break technology on the primary piping of APWRs.** Zdarek, J. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)); Joch, J.; Havel, R.; Ruscak, M. International Atomic Energy Agency, Vienna (Austria). Sep 1992. (CONF-9105343–: IAEA-Technical Committee meeting on materials for advanced water-cooled reactors, Plzen (Czechoslovakia), 14-17 May 1991). In *Materials for advanced water cooled reactors: Proceedings of a technical committee meeting held in Plzen Czechoslovakia, 14-17 May 1991.* [163] Order Number DE93609447. Source: OSTI; NTIS (US Sales Only); INIS.

The integrity assessment and leak-before-break application on the primary and other safety important piping requires detailed fracture mechanics and corrosion data base. The experience learned from the WWER/440 type W-230 and W-231 is summarized and recommendations for the APWR are stated. The main emphasis is on the properties of the homogeneous and heterogeneous welds. (author). 4 refs, 4 figs.

5399 (IAEA-TECDOC–665, pp. 133-142) **Modern manufacturing techniques in fabrication of components for advanced water cooled reactors.** Erve, M. (Siemens AG, Erlangen (Germany)); Schmidt, J. International Atomic Energy Agency, Vienna (Austria). Sep 1992. (CONF-9105343–: IAEA-Technical Committee meeting on materials for advanced water-cooled reactors, Plzen (Czechoslovakia), 14-17 May 1991). In *Materials for advanced water cooled reactors: Proceedings of a technical committee meeting held in Plzen Czechoslovakia, 14-17 May 1991.* [163] Order Number DE93609447. Source: OSTI; NTIS (US Sales Only); INIS.

The realization of new safety and engineering concepts (e.g. Basic Safety Concept, leak before break, break preclusion) as well as economical reasons intensify the optimization of reactor coolant components with respect to reduction of weldments. This implies the application of advanced steel making technologies, assuring accustomed quality and homogenous material properties even in case of huge and complex forgings. To achieve the required component quality, it is necessary to use optimized welding processes, e.g. narrow gap welding, TIG-orbital welding technique. For piping systems progressive use of modern manufacturing techniques for the production of fittings (inductive bending, cold bending, liquid bulge) assures further improvement of structural integrity. Recently a new fabrication technique has been introduced to the market which should be considered in manufacturing components for advanced water-cooled reactors: shape welding. Cost-benefit analyses of the production of parts by shape welding show that this process is a viable alternative to forging, particularly for parts of intricate geometry. The largely unexploited automation, development and innovation potential of this manufacturing process is a special challenge for future application. (author). 6 refs, 11 figs.

5400 (IAEA-TECDOC–665, pp. 156-160) **Material aspects of APWRs with respect to water chemistry and occupational doses.** Zmitko, M. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)); Kysela, J. International Atomic Energy Agency, Vienna (Austria). Sep 1992. (CONF-9105343–: IAEA-Technical Committee meeting on materials for advanced water-cooled reactors, Plzen (Czechoslovakia), 14-17 May 1991). In *Materials for advanced water cooled reactors: Proceedings of a technical committee meeting held in Plzen Czechoslovakia, 14-17 May 1991.* [163] Order Number DE93609447. Source: OSTI; NTIS (US Sales Only); INIS.

The choice criterions of the APWR primary circuit material are reviewed from point of view of reduction of occupational doses and radioactive waste formation during the operation period and after the finishing of service life. The analysis includes aspects of the choice of optimal primary water chemistry, corrosion resistance of materials and preconditioning of primary circuit internal surfaces. The Czechoslovak experience in the influence of primary material composition onto the NPPs radiation situation is discussed and there is the comparison of experimental results with the calculations providing by means of the mathematical modelling of corrosion product transport in the NPP primary circuit. (author). 9 refs, 8 figs, 1 tab.

5401 (IEN–34/92) **Simplified analysis of passive residual heat removal systems for small size PWR's.** Botelho, D.A. Instituto de Engenharia Nuclear (IEN), Rio de Janeiro, RJ (Brazil). Feb 1992. [66] (In Portuguese). Order Number DE93609466. Source: OSTI; NTIS (US Sales Only); INIS.

The function and general objectives of a passive residual heat removal system for small size PWR's are defined. The characteristic configuration, the components and the operation modes of this system are concisely described. A preliminary conceptual specification of this system, for a small size PWR of 400 MW thermal, is made analogous to the decay heat removal system of the AP-600 reactor. It is shown by analytic models that such passive systems can dissipate 2% of nominal power within the thermal limits allowed to the reactor fuel elements. (author).

5402 (IEN–40/92) **Directives and general design requirements for a small PWR.** Arrieta, L.A. Instituto de Engenharia

Nuclear (IEN), Rio de Janeiro, RJ (Brazil). Aug 1992. [40] (In Portuguese). Order Number DE93609467. Source: OSTI; NTIS (US Sales Only); INIS.

A proposal of directives and general requirements for the development of a small PWR conceptual design is presented. These directives address the main safety, performance and economic design aspects. The purpose is to use this work as a base for a wide discussion, involving all project participants, culminating with the definition of the final directives and general requirements. (author).

5403 (INIS-BR–2979) **Optimization of fuel management and control poison of a nuclear power reactor by dynamic programming.** Lima, C.A.R. de. Instituto Militar de Engenharia (IME), Rio de Janeiro, RJ (Brazil). 1977[130] (In Portuguese). Order Number DE93609468. Source: OSTI; NTIS (US Sales Only); INIS.

The distribution of fuel and control poison in a nuclear reactor was optimized by the method of Dynamic Programming. A 620 M We Pressurized Water Reactor similar to Angra-1 was studied. The reactor operation was simulated in a IBM-1130 computer. Two fuel shuffling schemes and three poison management schemes were simultaneously employed in the reactor divided into three regions of equal volume and two consecutive stages were studied in order to determine the influence of poison management on the optimum fuel management policy. When uniform poisoning on all the three regions was permitted the traditional out-in fuel management policy proved to be more economic. On introducing simultaneous poison management, the optimum fuel management sequence was found to be different. The results obtained indicate a stronger interaction between the fuel management and the poison management than anticipated in previous works. (author).

5404 (JAERI-M–92-117) **Solutions to NEANSC benchmark problems on 'Power Distribution within Assemblies (PDWA)' using the SRAC and GMVP.** Kugo, Teruhiko (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Nakagawa, Masayuki; Tsuchihashi, Keiichiro. Japan Atomic Energy Research Inst., Tokyo (Japan). Aug 1992. 75p. (In Japanese). Order Number DE93754296. Source: OSTI; NTIS; INIS.

An advancement or variety of PWR cores by introducing MOX fuel, burnable poison and so on, increases a heterogeneity in a core or an assembly. For the evaluation of the pin power distribution, the fine mesh flux reconstruction is required with the combination of an assembly calculation and a three dimensional core calculation with coarse mesh, instead of the combination of a two dimensional X-Y core calculation with fine mesh and a one dimensional axial core calculation for the conventional PWR core. The main purpose of the NEANSC benchmark problems entitled 'Power Distribution within Assemblies' is to compare the technique of the fine mesh flux reconstruction based on coarse mesh core calculation. In this report, we examine the validity of the reconstruction technique based on the coarse mesh core calculation using the Spline function, assembly calculation and heterogeneous fine mesh core calculation by built-in programs in the SRAC code using the groupwise Monte Carlo calculation with the GMVP code as reference. (author).

5405 (KFK–5072) **Development calculational procedures for the neutron physics design of advanced pressurized water reactors (APWR) with tight triangular lattices in hexagonal fuel assemblies.** Broeders, C.H.M. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Neutronenphysik und Reaktortechnik; Karlsruhe Univ. (T.H.) (Germany). Fakultaet fuer Maschinenbau. Aug 1992. 350p. (In German). Order Number DE93750862. Source: OSTI; NTIS (US Sales Only); INIS.

The new procedures for the calculation of infinite reactor zones build a synthesis of wellknown fast breeder (FBR) and light water reactor (LWR) methods. The data libraries are based on the 69 energy group structure of the WIMS code for thermal reactors and use the flexible storage mode of the FBR libraries. For the calculation of effective cross sections in the energy of neutron resonances, being very important in the APWR with its strongly epithermal neutron spectrum, several options are available. In most applications improved selfshielding tabulation formalisms (f-factor concept) are used. For more accurate investigations the fine flux programs ULFISP (own development) or RESABK (IKE, Stuttgart) may be selected. All cross section calculations use a modified version of the FBR code GRUCAL. Particularly the calculation of voided lattices may be improved at 69 groups with the program REMOCO or with a new 334 group library. The new calculational procedures could be qualified for a large number of LWR, APWR and FBR applications. The fuel assembly and whole core calculations are performed with available FBR methods. A new reactor core simulation program ARCOSI has been developed for the investigation of an APWR equilibrium core. The required cross sections come from fast interpolations of fuel assembly data on code-own libraries. The whole core calculations are performed with the fast nodal code HEXNODK, adopted from KWU. All calculational procedures are part of the powerful FBR code system KAPROS. (orig.).

5406 (KTM/E-B–119) **YKAe - Research programme on nuclear power plant systems behaviour and operational aspects of safety: Interim report January 1990 - May 1992.** Mattila, L.; Vanttola, T. (eds.). Ministry of Trade and Industry, Helsinki (Finland). Energy Dept. 1992. [183] Order Number DE93609469. Source: OSTI; NTIS; INIS.

Finland's energy research programmes.

The major part of nuclear energy research in Finland has been organised as five-year nationally coordinated research programs. The research programme on Systems Behaviour and Operational Aspects of Safety is under way during 1990-1994. Its annual volume has been about 35 person-years and its annual expenditure about FIM 18 million. Studies in the field on safe operational margins of nuclear fuel and reactor core concentrate on fuel high burn-up behaviour, VVER fuel experiments, and reactor core behaviour in complex reactivity transients such as 3-D phenomena and ATWS events. The PACTEL facility is used for the thermal hydraulic studies of the Loviisa type reactors (scaled 1:305). Validation of accident analysis codes is carried out by participation in international standard problems. Advanced foreign computer codes for severe reactor accidents are implemented, modified as needed and applied to level-2 PSAs and the improvement of accident management procedures. Fire simulation methods are tested using data from experiments in the German HDR facility. A nuclear plant analyzer for efficient safety analyses is being developed using the APROS process simulation environment. Computerized operator support systems are being studied in cooperation with the OECD Halden Project. The basic factors affecting plant operator activities and the development of their competence are being investigated. A comprehensive system for the control of plant operational safety is being developed by combining living PSA and safety indicators.

5407 (NUREG–1430-Vol.2) **Standard Technical Specifications, Babcock and Wilcox plants: Volume 2, Bases (Sections 2.0–3.3).** Nuclear Regulatory Commission, Washington, DC (United States). Div. of Operational Events Assessment. Sep 1992. 292p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This NUREG contains improved Standard Technical Specifications (STS) for Babcock and Wilcox (B&W) Plants and documents the positions of the Nuclear Regulatory Commission based on the B&W Owners Group's proposed STS. This document is the result of extensive technical meetings and discussions among the NRC staff, the Nuclear Steam Supply System (NSSS) Owners Groups, the NSSS vendors, and the Nuclear Management and Resources Council (NUMARC). The improved STS were developed based on the criteria in the interim Commission Policy Statement on Technical Specification Improvements for Nuclear Power Reactors, dated February 6, 1987. The improved STS will be used as the basis for individual nuclear power plant licensees to develop improved plant-specific technical specifications. This report contains three volumes. Volume 1 contains the Specifications for all chapters and sections of the improved STS. This document Volume 2, contains the Bases for Chapters 2.0 and 3.0, and Sections 3.1–3.3 of the improved STS. Volume 3 contains the Bases for Sections 3.4–3.10 of the improved STS.

5408 (NUREG–1430-Vol.3) **Standard Technical Specifications, Babcock and Wilcox Plants: Volume 3, Bases (Sections 3.4–3.9).** Nuclear Regulatory Commission, Washington, DC (United States). Div. of Operational Events Assessment. Sep 1992. 375p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This NUREG contains improved Standard Technical Specifications (STS) for Babcock and Wilcox (B&W) plants and documents the positions of the Nuclear Regulatory Commission (NRC) based on the B&W Owners Group's proposed STS. This document is the result of extensive technical meetings and discussions among the NRC staff, the Nuclear Steam Supply System (NSSS) Owners Groups, the NSSS vendors, and the Nuclear Management and Resources Council. The improved STS were developed based on the criteria in the interim Commission Policy Statement on Technical Specification Improvements for Nuclear Power Reactors, dated February 6, 1987. The improved STS will be used as the basis for developing improved plant-specific technical specifications by individual nuclear power plant licensees. This volume contains sections 3.4–3.9 which cover: Reactor coolant systems, emergency core cooling systems, containment systems, plant systems, electrical power systems, refueling operations.

5409 (NUREG–1431-Vol.3) **Standard Technical Specifications, Westinghouse plants: Volume 3, Bases (Sections 3.4–3.9).** Nuclear Regulatory Commission, Washington, DC (United States). Div. of Operational Events Assessment. Sep 1992. 542p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This NUREG contains improved Standard Technical Specifications (STS) for Westinghouse Plants and documents the positions of the Nuclear Regulatory Commission based on the Westinghouse Owners Group's proposed STS. This document is the result of extensive technical meetings and discussions among the NRC staff, the Nuclear Steam Supply System (NSSS) Owners Groups, the NSSS vendors, and the Nuclear Management and Resources Council (NUMARC). The improved STS were developed based on the criteria in the interim Commission Policy Statement on Technical Specification Improvements for Nuclear Power Reactors, dated February 6, 1987. The improved STS will be used as the basis for individual nuclear power plant licensees to develop improved plant-specific technical specifications. This report contains three volumes. Volume 1 contains the Specifications for all chapters and sections of the improved STS. Volume 2 contains the Bases for Chapters 2.0 and 3.0, and Sections 3.1–3.3 of the improved STS. This document, Volume 3, contains the Bases for Sections 3.4–3.9 of the improved STS.

5410 (NUREG–1432-Vol.1) **Standard technical specifications combustion engineering plants: Specifications, Volume 1.** Nuclear Regulatory Commission, Washington, DC (United States). Div. of Operational Events Assessment. Sep 1992. 446p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This report documents the results of the combined effort of the NRC and the industry to produce improved Standard Technical Specifications (STS) for Combustion Engineering Plants. The improved STS wee developed based on the criteria in the interim Commission Policy Statement on Technical Specification Improvements for Nuclear Power Reactors, dated February 6, 1987. The improved STS will be used as the basis for individual nuclear power plant licensees to develop improved plant-specific technical specifications. This report contains three volumes. This document, Volume 1, contains the Specifications for all chapters and sections of the improved STS. Volume 2 contains the Bases for Sections 3.4–3.9 of the improved STS.

2103 Power Reactors, Nonbreeding, Graphite Moderated

Refer also to citation(s) 5472, 5624, 5649

5411 (GA-A–21088) **Modular High Temperature Gas-Cooled Reactor heat source for coal conversion.** Schleicher, R.W. Jr.; Lewis, A.C. General Atomics, San Diego, CA (United States). Sep 1992. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-89SF17885. (CONF-9210185–1: International Atomic Energy Agency (IAEA) workshop on high temperature applications of nuclear energy, Ibaraki-ken (Japan), 19-20 Oct 1992). Order Number DE93001418. Source: OSTI; NTIS; INIS; GPO Dep.

In the industrial nations, transportable fuels in the form of natural gas and petroleum derivatives constitute a primary energy source nearly equivalent to that consumed for generating electric power. Nations with large coal deposits have the option of coal conversion to meet their transportable fuel demands. But these processes themselves consume huge amounts of energy and produce undesirable combustion by-products. Therefore, this represents a major opportunity to apply nuclear energy for both the environmental and energy conservation reasons. Because the most desirable coal conversion processes take place at 800°C or higher, only the High Temperature Gas-Cooled Reactors (HTGRs) have the potential to be adapted to coal conversion processes. This report provides a discussion of this utilization of HTGR reactors.

5412 (IA–1471, pp. 21) **Fission product release following a severe accident in a medium-sized HTGR.** Ron, S.; Szabo, J.; Tzoref, J. Israel Atomic Energy Commission, Tel Aviv (Israel). Aug 1992. In *Research laboratories annual report 1991.* [247] Order Number DE93609217. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. HTGR TYPE REACTORS/reactor accidents; REACTOR ACCIDENTS/computerized simulation; FISSION PRODUCT RELEASE; SOURCE TERMS

5413 (IA–1471, pp. 22) **Comparing thermal-hydraulic aspects of small modular and medium-sized High-Temperature Gas Reactor plants.** Gal, D.; Saphier, D.; Shapira, M. Israel Atomic Energy Commission, Tel Aviv (Israel). Aug 1992. In *Research laboratories annual report 1991.* [247] Order Number DE93609217. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. HTGR TYPE REACTORS/loss of flow; LOSS OF FLOW/computerized simulation

5414 (IA–1471, pp. 23) **Dynamic modelling of gas-cooled reactor thermal hydraulics with the DSNP.** Saphier, D.; Gal, D.; Shapira, M. Israel Atomic Energy Commission, Tel Aviv (Israel). Aug 1992. In *Research laboratories annual report 1991.* [247] Order Number DE93609217. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. HTGR TYPE REACTORS/reactor cooling systems; COMPUTERIZED SIMULATION

5415 (IA–1471, pp. 24) **Transient analysis in a medium-sized High-Temperature reactor power plant.** Shapira, M.; Gal, D.; Saphier, D. Israel Atomic Energy Commission, Tel Aviv (Israel). Aug 1992. In *Research laboratories annual report 1991.* [247] Order Number DE93609217. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. HTR REACTOR/transients; COMPUTERIZED SIMULATION; TRANSIENTS; REACTIVITY

5416 (IEA-PUB–519) **Multipurpose nuclear process heat for energy supply in Brazil.** Hansen, U.; Inden, P.; Oesterwind, D.; Hukai, R.Y.; Pessine, R.T.; Pieroni, R.R.; Visoni, E. Instituto de Pesquisas Energeticas e Nucleares (IPEN), Sao Paulo, SP (Brazil). Nov 1978. [17] Order Number DE93609477. Source: OSTI; NTIS (US Sales Only); INIS.

The industrialized nations require 75% of the energy as heat and it is likely that developing countries in the course of industrialization will show a comparable energy consumption structure. The High Temperature Reactor (HTR) allows the utilization of nuclear energy at high temperatures as process heat. In the Federal Republic of Germany (FRG) the development in the relevant technical areas is well advanced and warrants investigation as a matter for transfer to Brazil. In Brazil nuclear process heat finds possible applications in steel making, shale oil extraction, petroleum refining, and in the more distant future coal gasification with distribution networks. Based on growth forecasts for these industries a theoretical potential market of 38-53 GW (th) can be identified. At present nuclear process heat is marginally more expensive than conventional fossil technologies but the anticipated development is expected to add an economic incentive to the emerging necessity of providing a sound energy base in the developing countries. (author).

5417 (INIS-mf–14100) **R+D works for the further development of high temperature reactors. Development and testing of a pilot blower with magnetic bearings. Phase 1 - plans**

ready for construction. Phase 2 - construction and testing. Final report 1.11.1986 - 30.04.1991. ABB Kraftwerke AG, Mannheim (Germany); Bundesministerium fuer Forschung und Technologie, Bonn (Germany). 26 Feb 1991 91p. (In German). Contract BMFT 03BBC2120;BMFT 03ABB2013. Order Number DE93750334. Source: OSTI; NTIS (US Sales Only); INIS.

The development of helium compressors in magnetic bearings as cooling blowers for HTR's made a considerable contribution to the extension of Germany's technical potential. Magnetic bearings open up new possibilities with simultaneous savings due to the reduction in friction and wear. With the use of active magnetic bearings for cooling gas blowers any potential contamination of the primary circuit by oil is completely excluded. The oil system is omitted and therefore so are a large number of safety requirements and technical layout conditions. The keywords here are: safe inclusion of radio-activity, fire and explosion protection, omission of oil plant spatially separated but necessarily close to the blowers and the reactor, omission of removal of used bearing oil from the primary area. One would expect that the dynamic rotor properties of blower shafts with magnetic bearings are better than those with oil bearings, as bearing damping can be provided in the region of critical speeds. (orig./GL).

5418 (INIS-mf–14102) **R+D works for the further development of high temperature reactors. (1) Captive bearing experiments for active magnetic bearings. (2) Captive bearing test for HTR blowers. Final report 1.10.1983 - 31.3.1991.** ABB Kraftwerke AG, Mannheim (Germany); Hochtemperatur-Reaktorbau GmbH, Mannheim (Germany); Bundesministerium fuer Forschung und Technologie, Bonn (Germany). 14 Mar 1991 34p. (In German). Contract BMFT 03BBC2085;BMFT 03HRB206;BMFT 03BBC2117;BMFT 03HRB2 Order Number DE93750331. Source: OSTI; NTIS (US Sales Only); INIS.

When using active magnetic bearings as blower shaft bearings, blower motors and bearings must be protected against mechanical damage in case of faults (example: total electrical supply failure due to the supply cables breaking). So-called captive bearings are provided, in order to be able to shut the blowers down safely in such faults. These captive bearings are roller bearings which are additionally fitted in the area of the blower shaft bearings, to prevent mechanical contact between the blower rotor and stator. As there was little experience available for the given boundary conditions, such as - speed, - acceleration, - bearing load, - bearing dimensions, - ambient conditions, appropriate development and tests had to be carried out. It was important to determine suitable captive bearings and the necessary ambient conditions, which will make it possible to support the failures of the magnetic bearings to be expected in 40 years' operation of the reactor without damage and to meet the requirements of the captive bearings. (orig./GL).

5419 (JAERI-M–92-090) **Proceedings of the 2nd technical meeting on high temperature gas-cooled reactors.** Japan Atomic Energy Research Inst., Tokyo (Japan). Jul 1992. 262p. (In Japanese). (CONF-9203213–: 2. technical meeting on High Temperature Gas-cooled Reactors, Tokai (Japan), 11-12 Mar 1992). Order Number DE93754285. Source: OSTI; NTIS; INIS.

From the point of view for establishing and upgrading the technology basis of HTGRs, the 2nd Technical Meeting on High Temperature Gas-cooled Reactors (HTGRs) was held on March 11 and 12, 1992, in Tokai Research Establishment in order to review the present status and the results of Research and Development (R and D) of HTGRs, to discuss on the items of R and D which should be promoted more positively in the future and then, to help in determining the strategy of development of high temperature engineering and examination in JAERI. At the 2nd Technical Meeting, which followed the 1st Technical Meeting held in February 1990 in Tokai Research Establishment, expectations to the High Temperature Engineering Test Reactor (HTTR), possible contributions of the HTGRs to the preservation of the global environment and the prospect of HTGRs were especially discussed, focusing on the R and D of Safety, high temperature components and process heat utilization by the experts from JAERI as well as universities, national institutes, industries and so on. This proceedings summarizes the papers presented in the oral sessions and materials exhibited in the poster session at the meeting and will be variable as key materials for promoting the R and D on HTGRs from now on. (author).

2104 Power Reactors, Nonbreeding, Otherwise Moderated Or Unmoderated

Refer also to citation(s) 5649

5420 (CONF-9210209–1) **Fracture mechanics and full scale pipe break testing for DOE's New Production Reactor-Heavy Water Reactor.** Poole, A.B.; Clinard, J.A.; Battiste, R.L.; Hendrich, W.R. Oak Ridge National Lab., TN (United States). [1992]. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Organization for Economic Co-Operation Development/International Atomic Energy Agency/Commision of Safety Nuclear Installations (OECD/IAEA/CSNI) joint international specialists meeting on fracture mechanics verification by large scale testing; Knoxvi Order Number DE93002829. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Oak Ridge National Laboratory (ORNL) is completing a major task for the Department of Energy (DOE) in the demonstration that the primary piping of the New Production Reactor-Heavy Water Reactor (NPR-HWR), with its relatively moderate temperature and pressure, should not suffer an instantaneous Double-Ended-Guillotine-Break (DEGB) under design basis loadings and conditions. The approach to showing the improbability of an instantaneous DEGB for HWR primary piping required a major facility (Pipe Impact Test Facility, PITF) to apply all possible design loads, including an equivalent major earthquake (called the SSE earthquake). The facility was designed and built at ORNL in six months. The test article, a 20-ft (6.1 m) long 16-in. (406 mm) diameter SCH-40 pipe of stainless steel 316LN material was fabricated to exacting standards and inspections following the nuclear industry standard practices. A flaw was machined and fatigued into the pipe at a tungsten inert gas (TIG) butt weld (ER316L weld wire) as an initial condition. The flaw/crack was sized to be beyond the worst-case flaw that HWR piping could see in 60 years of service-if all leak detection systems and if all crack inspection systems failed to notice the flaw's existence. Since October 1991, the first test article was subjected to considerable overloadings. The pipe was impacted 104 times at levels equal and well beyond the SSE loadings. In addition, over 560,000 fatigue cycles and numerous purposeful static overloads were applied in order to extend the flaw to establish the data necessary to confirm fracture mechanics theories, and more importantly, to simply demonstrate that instantaneous DEGB is highly improbable for the relatively moderate energy system.

5421 (DPW–5365) **[Delays in the Savannah River program].** Mackey, B.H. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Atomic Energy Div. 13 May 1952. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–218). Order Number DE93001245. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Information related to construction schedules of heavy water reactors at Savannah River Plant, May, 1952, is presented.

2105 Power Reactors, Breeding

Refer also to citation(s) 5463, 5472, 5649, 5922, 7311, 7313, 7314

5422 (ANL/MCT/CP–76404) **Behavior of EBR-II Mk-V-type fuel elements in simulated loss-of-flow tests.** Liu, Y.Y. (Argonne National Lab., IL (United States)); Tsai, H.; Billone, M.C.; Holland, J.W.; Kramer, J.M. Argonne National Lab., IL (United States). Materials and Components Technology Div. Nov 1992. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-921102–31: Joint American Nuclear Society (ANS)/European Nuclear Society (ENS) international meeting on fifty years of controlled nuclear chain reaction: past, present, and future, Chicago, IL (United States), 15-20 Nov 1992). Order Number DE93002908. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses three furnace heating tests which were conducted with irradiated, HT9-clad and U-19wt.%Pu-l0wt.%Zr-alloy fuel, Mk-V-type fuel elements in the Alpha-Gamma Hot Cell

Facility at Argonne National Laboratory, Illinois. In general, very significant safety margins for fuel-element cladding breaching have been demonstrated in these tests, under conditions that would envelop a bounding unlikely loss-of-flow event in EBR-II. Highlights of the test results will be given, as well as discussions of the cladding breaching mechanisms, axial fuel motion, and fuel surface liquefaction found in high-temperature testing of irradiated metallic fuel elements.

5423 (ANL/MCT/CP–76420) **Fuel/cladding compatibility in high-burnup U-19Pu-10Zr/HT9-clad fuel at elevated temperatures.** Cohen, A.B.; Tsai, H.; Neimark, L.A. Argonne National Lab., IL (United States). Materials and Components Div. Nov 1992. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-921102–29: Joint American Nuclear Society (ANS)/European Nuclear Society (ENS) international meeting on fifty years of controlled nuclear chain reaction: past, present, and future, Chicago, IL (United States), 15-20 Nov 1992). Order Number DE93002907. Source: OSTI; NTIS; INIS; GPO Dep.

This paper summarizes the most recent results of a continuing experimental effort to study compatibility issues of irradiated metallic fuel and cladding at elevated temperatures that may be encountered beyond those of nominal steady-state conditions.

5424 (IEN–25/91) **Axial heterogeneous core concept applied for super phoenix reactor.** Batista, J.L.; Renke, C.A.C.; Waintraub, M.; Santos Bastos, W. dos; Brito Aghina, L.O. de. Instituto de Engenharia Nuclear (IEN), Rio de Janeiro, RJ (Brazil). Nov 1991. [24] (In Portuguese). Order Number DE93609484. Source: OSTI; NTIS (US Sales Only); INIS.

Always maintaining the current design rules, this paper presents a parametric study on the type of axial heterogeneous core concept (CHA), utilizing a core of fast reactor Super Phenix type, reaching a maximum thermal burnup rate of 150000 M W d/t and being managed in single batch. (author).

5425 (IEN–26/91) **Neutronic analysis concerning the utilization of mixed U N-Pu N nitride fuel for fast reactors.** Renke, C.A.C.; Batista, J.L.; Waintraub, M.; Santos Bastos, W. dos; Brito Aghina, L.O. de. Instituto de Engenharia Nuclear (IEN), Rio de Janeiro, RJ (Brazil). Aug 1991. [26] (In Portuguese). Order Number DE93609485. Source: OSTI; NTIS (US Sales Only); INIS.

Neutronic behavior of mixed UN-PuN nitride fuel in substitution of the mixed oxide U O_2 - Pu O_2 for fast reactors is discussed with focus on Super Phenix I. Characteristics parameters of both cores are calculated and compared and the results presented show a great advantage for the nitride fuel, pointing out a larger performance of fuel elements in the core and an effective reduction of reactivity loss during the cycle. (author).

5426 (IEN–32/91) **Neutronic study using oxide and nitride fuels for the Super Phenix 2 reactor.** Batista, J.L.; Renke, C.A.C. Instituto de Engenharia Nuclear (IEN), Rio de Janeiro, RJ (Brazil). Nov 1991. [53] (In Portuguese). Order Number DE93609486. Source: OSTI; NTIS (US Sales Only); INIS.

This report presents a neutronic analysis and a description of the Super Phenix 2 reactor, taken as reference. We present the methodology and results for cell and global reactor calculations for oxide (U O_2 _ Pu O_2) and nitride (U N - Pu N) fuels. To conclude we compare the performance of oxide and nitride fuels for the reference reactor. (author).

2106 Power Reactors, Mobile, Propulsion, Package, and Transportable

Refer also to citation(s) 5228, 5656, 5658, 5764

5427 (ANL-EP-TM–92/1) **Core length testable reactor concept neutronic analysis.** Hanan, N.A.; Bhattacharyya, S.K. Argonne National Lab., IL (United States). Engineering Physics Div. Sep 1992. 45p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93001337. Source: OSTI; NTIS; GPO Dep.

Development work on thermionic reactor systems has been ongoing in the US since the early 1950s. While significant successes were achieved, progress has been hampered by frequent changes in direction and funding instabilities (as has been true for many high technology initiatives). The recent Air Force thermionics initiative (1991) represents the latest in thermionics reactor development in the US. This Air Force initiative called for the development of thermionics reactors with the output power of about 40 kWe, and which incorporated the features of testability, fabricability, low development cost, high level of safety and reliability, and survivability. Several concepts were analyzed to define a design that would meet all the requirements set forth by the Air Force. This report describes the methodology used, the different designs analyzed and reasons for the evolution of the design, and presents the results for the different concepts.

5428 (JAERI-M–92-123) **Static and dynamic performance tests of nuclear powered ship Mutsu reactor (report on nuclear ship Mutsu power-up tests).** Ishida, Toshihisa (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Kusunoki, Tsuyoshi; Ochiai, Masa-aki; Tanaka, Yoshimi; Inoue, Kimio; Yao, Toshiaki; Kamai, Satoshi; Kitamura, Toshikatsu. Japan Atomic Energy Research Inst., Tokyo (Japan). Aug 1992. 116p. (In Japanese). Order Number DE93754310. Source: OSTI; NTIS; INIS.

The power-up tests of the Mutsu reactor were performed from March 29th 1990 to December 14th. The tests were divided into six phases: The tests Phase 0 and Phase 1 were done in the state that the ship was moored at the quay of Sekinehama port in March and April; The tests Phase 2, Phase 3, Phase 4, and Phase 5 were done on the Pacific Ocean from July to December. Present report describes the test results on the static and dynamic plant performance. On static plant performance tests, there are 13 test items including measurements of primary system heat balance at low and high power levels, a virgin run of feed water pump with SG steam, a change-over test of steam supply of auxiliary boiler to SG. On the dynamic plant performance, there are 11 test items including a test of reactor power auto-control system, a test of main feed water auto-control system, a test of small load variation, a load increasing test, a turbine trip test, tests of ahead and astern maneuvering, a test of single loop operation, and a reactor scram test. The reactor power for each item's test was increased step by step from zero power to the goal of rated power of 100 %, 36 MWt. In order to confirm proper reactor system performance, criteria were laid down for the static and dynamic tests: for example, (1) reactor scram shall not occur, (2) pressurizer relief valve and steam generator safety valve shall not work, and (3) after the transients reactor systems shall become the steady state without manual adjustment of the reactor control system. The test results satisfied these criteria and some of test data showed that reactor had much more margin in any performance for design. It is verified, therefore, that the Mutsu reactor systems have adequate performances as a marine reactor and that one is capable to respond smoothly and safely to the load of ship's demand. (author).

5429 (SAND–92-1350C) **Space nuclear thermal propulsion nuclear element tests at Sandia National Laboratories.** Mitchell, G.W. Sandia National Labs., Albuquerque, NM (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930103–13: 10. symposium on space nuclear power and propulsion, Albuquerque, NM (United States), 10-14 Jan 1993). Order Number DE93002301. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report discusses Nuclear Element Tests (NET) which are being performed as part of the US Air Force Space Nuclear Thermal Propulsion (SNTP) Program to evaluate high performance fuel elements intended for use in future nuclear propulsion systems. The NET experiments are to be performed at the Sandia National Laboratories (SNL's) Annular Core Research Reactor (ACRR). Objectives of these experiments are to provide engineering validation and demonstration of critical-fuel-element-related technologies and an experimental data base to support analytical design methods for the SNTP Program. Currently, hardware for the first two fueled NET experiments has been fabricated, and cold flow tests have been accomplished with a representative set of hardware to assure the experimental capability to achieve test objectives in-reactor. Assembly of the first NET experiment to test a representative nuclear

fuel elements is in progress, and planned operational sequences have been defined.

5430 (SAND–92-2009C) **Test facilities for evaluating nuclear thermal propulsion systems.** Beck, D.F. (Sandia National Labs., Albuquerque, NM (United States)); Allen, G.C.; Shipers, L.R.; Dobranich, D.; Ottinger, C.A.; Harmon, C.D.; Fan, W.C.; Todosow, M. Sandia National Labs., Albuquerque, NM (United States). 22 Sep 1992. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930103–17: 10. symposium on space nuclear power and propulsion, Albuquerque, NM (United States), 10-14 Jan 1993). Order Number DE93002468. Source: OSTI; NTIS; INIS; GPO Dep.

Interagency panels evaluating nuclear thermal propulsion (NTP) development options have consistently recognized the need for constructing a major new ground test facility to support fuel element and engine testing. This paper summarizes the requirements, configuration, and baseline performance of some of the major subsystems designed to support a proposed ground test complex for evaluating nuclear thermal propulsion fuel elements and engines being developed for the Space Nuclear Thermal Propulsion (SNTP) program. Some preliminary results of evaluating this facility for use in testing other NTP concepts are also summarized.

5431 (SAND–92-7295C) **F2D: A two-dimensional compressible gas flow code.** Suo-Anttila, A. (Science Applications International Corp., Albuquerque, NM (United States)). Sandia National Labs., Albuquerque, NM (United States). 11 Sep 1992. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930103–20: 10. symposium on space nuclear power and propulsion, Albuquerque, NM (United States), 10-14 Jan 1993). Order Number DE93003239. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The F2D computer code is a general-purpose, two-dimensional, fully compressible thermal-fluids code that models most phenomena found in experimental environments with coupled fluid flow and heat transfer. The code solves momentum, continuity, gas energy, and structure energy equations, simultaneously utilizing a predictor-corrector solution algorithm. The F2D code applied to a particle-bed reactor operating at 5 MW/L with a flow-control cold frit, revealed a skew in the temperature contours caused by two-dimensional flow effects. A thermal-fluid stability analysis of particle-bed and NERVA type reactors reveals similar behavior for the stability threshold.

2107 Regulation and Licensing

5432 (IAEA-TECDOC–663) **Efficiency in development and implementation of safety regulations for the use of ionizing radiation.** International Atomic Energy Agency, Vienna (Austria). Aug 1992. [51] Order Number DE93609749. Source: OSTI; NTIS (US Sales Only); INIS.

This report addresses the effective and efficient organization of the work of regulatory authorities responsible to the public for assuring regulatory control of the use of ionizing radiation consistent with rational policies and objectives. Its purpose is to outline parameters that influence decisions about the structure of regulatory programmes, to explore combinations of approaches to structure such programmes, and to present available cost-saving techniques. 7 refs, 1 tab.

5433 (INIS-XN–401) **AECB Cost Recovery Fees Regulations, amendment.** Canada. 6 Nov 1991. [4] (In English, French). Order Number DE93609750. Source: OSTI; NTIS (US Sales Only); INIS.

The amendment to the Regulations was published on 24 October 1991 (SOR/91-590,Canada Gazette Part II, Vol.125, No 23). It modifies the list of institutions exempted from paying cost recovery fees (licence fees) to the Atomic Energy Control Board. The exemptions now include educational and health care institutions as well as Departments. (NEA).

5434 (NUREG–0304-Vol.17-No.2) **Regulatory and technical reports (Abstract Index Journal): Compilation for second quarter, April–June 1992: Volume 17, No. 2.** Nuclear Regulatory Commission, Washington, DC (United States). Div. of Freedom of Information and Publications Services. Sep 1992. 50p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This journal includes all formal reports in the NUREG series prepared by the NRC staff and contractors; proceedings of conferences and workshops; as well as international agreement reports. The entries in this compilation are indexed for address by title and abstract, secondary report number, personal author, subject, NRC organization for staff and international agreements, contractor, international organization, and licensed facility.

5435 (NUREG–0304-Vol.17-No.3) **Regulatory and technical reports (Abstract Index Journal): Compilation for third quarter 1992, July–September, Volume 17, No. 3.** Nuclear Regulatory Commission, Washington, DC (United States). Div. of Freedom of Information and Publications Services. Nov 1992. 51p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This journal includes all formal reports in the NUREG series prepared by the NRC staff and contractors, proceedings of conferences and workshops, grants, and international agreement reports. The entries in this compilation are indexed for access by title and abstract, secondary report number, personal author, subject, NRC organization for staff and international agreements, contractor, international organization, and licensed facility.

5436 (NUREG–0386-Digest-6-Rev.4) **United States Nuclear Regulatory Commission staff practice and procedure digest: Commission, Appeal Board and Licensing Board decisions, July 1972–December 1991: Digest 6, Revision 4.** Nuclear Regulatory Commission, Washington, DC (United States). Office of the General Counsel. Nov 1992. 685p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This 4th revision of the sixth edition of the NRC Practice and Procedure Digest contains a digest of a number of Commission, Atomic Safety and Licensing Appeal Board, and Atomic Safety and Licensing Board decisions issued during the period of July 1, 1972 to December 31, 1991, interpreting the NRC's Rules of Practice in 10 CFR Part 2.

5437 (NUREG–0540-Vol.14-No.8) **Title list of documents made publicly available, August 1–31, 1992.** Nuclear Regulatory Commission, Washington, DC (United States). Div. of Freedom of Information and Publications Services. Oct 1992. 325p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This document is a monthly publication containing descriptions of information received and generated by the US Nuclear Regulatory Commission (NRC). This information includes (1) docketed material associated with civilian nuclear power plants and other uses of radioactive materials, and (2) nondocketed material received and generated by NRC pertinent to its role as a regulatory agency. The following indexes are included: Personal Author, corporate Source, Report Number, and Cross Reference of Enclosures to Principal Documents.

5438 (NUREG–0540-Vol.14-No.9) **Title list of documents made publicly available, September 1–30, 1992: Volume 14, No. 9.** Nuclear Regulatory Commission, Washington, DC (United States). Div. of Freedom of Information and Publications Services. Nov 1992. 339p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This document is a monthly publication containing descriptions of information received and generated by the US Nuclear Regulatory commission (NRC). This information includes (1) docketed material associated with civilian nuclear power plants and other uses of radioactive materials, and (2) nondocketed material received and generated by NRC pertinent to its role as a regulatory agency. The following indexes are included: Personal Author, Corporate Source Report Number and Cross Reference of Enclosures to Principal Documents.

5439 (NUREG–0936-Vol.11-No.3) **NRC regulatory agenda: Quarterly report, July–September 1992: Volume 11, No. 3.** Nuclear Regulatory Commission, Washington, DC (United States). Div. of Freedom of Information and Publications Services. Nov

1992. 141p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This document provides a compilation of all rules on which the NRC has recently completed action, or has proposed action, or is considering action, and all petitions for rulemaking which have been received by the Commission and are pending disposition by the Commission. The Regulatory Agenda is updated and issued each quarter.

5440 (NUREG–1303-Rev.2) **Incident investigation manual: Revision 2.** Nuclear Regulatory Commission, Washington, DC (United States). Div. of Operational Assessment. Sep 1992. 140p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; GPO.

This manual prescribes guidelines for the conduct of investigative activities of the US Nuclear Regulatory Commission (NRC) Incident Investigation Teams (IITs). The purpose of this manual is to provide IITs guidance to ensure that NRC investigations of significant events are timely, structured, coordinated, and formally administered. The guidelines are intended to assist the investigation rather than limit the initiatives and good judgment of the IIT leader or members. ne IIT leader and team members should use their experience and those techniques that provide the most confidence in assuring the IIT objectives are achieved. These guidelines address IIT activation, conduct of the investigation, conducting interviews, treatment of quarantined equipment, preparation of the team report and followup of staff actions.

5441 (NUREG/CR–4012-Vol.3) **Replacement energy costs for nuclear electricity-generating units in the United States: 1992–1996: Volume 3.** VanKuiken, J.C. (Argonne National Lab., IL (United States)); Guziel, K.A.; Willing, D.L.; Buehring, W.A. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Regulatory Applications; Argonne National Lab., IL (United States). Oct 1992. 245p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract W-31109-ENG-38. (ANL/AA–30-Vol.3). Source: OSTI; NTIS; INIS; GPO.

Seasonal replacement energy costs are estimated for potential short-term shutdowns of 112 nuclear electricity-generating units. These estimates were developed to help the US Nuclear Regulatory Commission (NRC) establish regulatory policies, particularly those requiring safety modifications that might necessitate temporary reactor shutdowns. Cost estimates were derived from probabilistic production-cost simulations of pooled utility-system operations. Factors affecting replacement energy costs, such as random unit failures, maintenance and refueling requirements, and load variations, are treated in the analysis. Seasonal costs are presented for the five-year period beginning with 1992 and ending with 1996. This information updates cost estimates that were developed previously for the NRC and published in NRC Report NUREG/CR-4012, Vols. 1 and 2. The updates were undertaken to extend the time frame of cost estimates and to account for recent changes in utility-system conditions, such as fluctuations in fuel prices, changes in construction and retirement schedules, and adjustments to system demand projections.

2108 Economics

Refer also to citation(s) 5095, 5441

5442 (IAEA-TECDOC–650, pp. 152-159) **Improvements to the quality of the estimates of US uranium reserves.** Nikodem, Z.D. (Department of Energy, Washington, DC (United States). Nuclear and Alternate Fuels Div.). International Atomic Energy Agency, Vienna (Austria); Nuclear Energy Agency, 75 - Paris (France). Jun 1992. (CONF-9108224–: Technical committee meeting on new developments in uranium exploration, resources, production and demand, Vienna (Austria), 26-29 Aug 1991). In *New developments in uranium exploration, resources, production and demand: Proceedings of a technical committee meeting held in Vienna, 26-29 August 1991.* 258p. Order Number DE93607128. Source: OSTI; NTIS (US Sales Only); INIS.

Extensive work has been done in USA on estimation of uranium reserves. Government's role in uranium raw materials shifted from support of military programs to assessing the supply available for commercial power generation. A comprehensive system evolved in which Government staff estimated reserves over a range of cost levels using standardized estimation methodology and criteria. The program was assigned to the Energy Information Administration (EIA) of DOE in 1983 which has the responsibility for reporting on energy resources. As uranium supply had increased and demand had decreased, there was less concern about the adequacy of resources. In this situation, and with reduced staffing levels, the EIA adopted a two part interim approach to preparing reserve estimates. One used questionnaires to obtain uranium company estimates of their economic and subeconomic reserves. A second approach modified the earlier detailed government property estimates to account for production. The EIA developed a new system with the assistance of consultants and the uranium industry. Goal of the new system is to produce one set of estimates at various cost categories based on a rigorous adherence to EIA criteria. Initial information is gathered from the industry through a revised annual questionnaire. Company estimates that conform to EIA standards are incorporated into the EIA reserve database. Additional information is gathered for those estimates requiring clarification, primarily through detailed technical conferences with company staff. The EIA has the capability to prepare independent reserve estimates from basic drill hole data when required. Uranium reserves estimated for 1990 by EIA include the initial results from the new methodology. The cooperation and support of the uranium industry have been excellent. Detailed evaluation of properties is continuing. Further work is being directed toward improving estimation techniques.

2109 Process Heat Reactors

Refer also to citation(s) 5416

22 NUCLEAR REACTOR TECHNOLOGY

2201 Theory and Calculation

Refer also to citation(s) 5427, 5507, 5524, 5604, 7018, 7051, 7461, 7462, 7463, 7464

5443 (ANL/CP–75373) **Biases in Monte Carlo eigenvalue calculations.** Gelbard, E.M. Argonne National Lab., IL (United States). [1992]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-921209–3: International Association Mathematics and Computers Simulation (IMACS) international symposium on mathematical modelling and computer simulation, Bangalore (India), 7-11 Dec 1992). Order Number DE93004189. Source: OSTI; NTIS; INIS; GPO Dep.

The Monte Carlo method has been used for many years to analyze the neutronics of nuclear reactors. In fact, as the power of computers has increased the importance of Monte Carlo in neutronics has also increased, until today this method plays a central role in reactor analysis and design. Monte Carlo is used in neutronics for two somewhat different purposes, i.e., (a) to compute the distribution of neutrons in a given medium when the neutron source-density is specified, and (b) to compute the neutron distribution in a self-sustaining chain reaction, in which case the source is determined as the eigenvector of a certain linear operator. In (b), then, the source is not given, but must be computed. In the first case (the "fixed-source" case) the Monte Carlo calculation is unbiased. That is to say that, if the calculation is repeated ("replicated") over and over, with independent random number sequences for each replica, then averages over all replicas will approach the correct neutron distribution as the number of replicas goes to infinity. Unfortunately, the computation is not unbiased in the second case, which we discuss here.

5444 (ANL/EP/CP–77800) **A comparison of WIMS-D4 and WIMS-D4m generated cross-section data with Monte Carlo.** Woodruff, W.L. (Argonne National Lab., IL (United States)); Deen, J.R.; Costescu, C.I. Argonne National Lab., IL (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9209266–4: 1992 international meeting on reduced enrichment for research and

test reactors, Roskilde (Denmark), 27 Sep - 1 oct 1992). Order Number DE93002933. Source: OSTI; NTIS; INIS; GPO Dep.

Cross-section and related data generated by a modified version of the WIMS-D4 code for both plate and rod type research reactor fuel are compared with Monte Carlo data from the VIM code. The modifications include the introduction of a capability for generating broad group microscopic data and to write selected microscopic cross-sections to an ISOTXS file format. The original WIMS-D4 library with H in ZrH, and ^{166}Er and ^{167}Er added gives processed microscopic cross-section data that agree well with VIM ENDF/B-V based data for both plate and TRIGA cells. Additional improvements are in progress including the capability to generate an ENDF/B-V based library.

5445 (ANL/RA/CP–77740) **Reactor benchmarks and integral data testing and feedback into ENDF/B-VI.** McKnight, R.D. (Argonne National Lab., IL (United States)); Williams, M.L. Argonne National Lab., IL (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-921046–10: Symposium on nuclear data evaluation methodology, Upton, NY (United States), 12-16 Oct 1992). Order Number DE93002920. Source: OSTI; NTIS; INIS; GPO Dep.

The role of integral data testing and its feedback into the ENDF/B evaluated nuclear data files are reviewed. The use of the CSEWG reactor benchmarks in the data testing process is discussed and selected results based on ENDF/B Version VI data are presented. Finally, recommendations are given to improve the implementation in future integral data testing of ENDF/B.

5446 (CONF-910414–38) **Variational nodal solution algorithms for multigroup criticality problems.** Carrico, C.B.; Lewis, E.E. Northwestern Univ., Evanston, IL (United States). Dept. of Mechanical Engineering. [1991]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER12810 ;W-31109-ENG-38. From International topical meeting on advances in mathematics, computation and reactor physics; Pittsburgh, PA (United States); 28 Apr - 2 may 1991. Order Number DE93003462. Source: OSTI; NTIS; INIS; GPO Dep.

Variational nodal transport methods are generalized for the treatment of multigroup criticality problems. The generation of variational response matrices is streamlined and automated through the use of symbolic manipulation. A new red-black partitioned matrix algorithm for the solution of the within-group equations is formulated and shown to be at once both a regular matrix splitting and a synthetic acceleration method. The methods are implemented in X- Y geometry as a module of the Argonne National Laboratory code DIF3D. For few group problems highly accurate P_3 eigenvalues are obtained with computing times comparable to those of an existing interface-current nodal transport method.

5447 (CONF-910414–39) **A discrete ordinate response matrix method for massively parallel computers.** Hanebutte, U.R.; Lewis, E.E. Northwestern Univ., Evanston, IL (United States). Dept. of Mechanical Engineering. [1991]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER12810. From International topical meeting on advances in mathematics, computation and reactor physics; Pittsburgh, PA (United States); 28 Apr - 2 may 1991. Order Number DE93003463. Source: OSTI; NTIS; INIS; GPO Dep.

A discrete ordinate response matrix method is formulated for the solution of neutron transport problems on massively parallel computers. The response matrix formulation eliminates iteration on the scattering source. The nodal matrices which result from the diamond-differenced equations are utilized in a factored form which minimizes memory requirements and significantly reduces the required number of algorithm utilizes massive parallelism by assigning each spatial node to a processor. The algorithm is accelerated effectively by a synthetic method in which the low-order diffusion equations are also solved by massively parallel red/black iterations. The method has been implemented on a 16k Connection Machine-2, and S_8 and S_{16} solutions have been obtained for fixed-source benchmark problems in X–Y geometry.

5448 (CONF-910535–10) **An evaluation of neural networks for identification of system parameters in reactor noise signals.** Miller, L.F. Tennessee Univ., Knoxville, TN (United States). Dept. of Nuclear Engineering. [1991]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG07-88ER12824. From 6. specialists meeting on reactor noise (SMORN); Gatlinburg, TN (United States); 19-24 May 1991. Order Number DE93003545. Source: OSTI; NTIS; INIS; GPO Dep.

Several backpropagation neural networks for identifying fundamental mode eigenvalues were evaluated. The networks were trained and tested on analytical data and on results from other numerical methods. They were then used to predict first mode break frequencies for noise data from several sources. These predictions were, in turn, compared with analytical values and with results from alternative methods. Comparisons of results for some data sets suggest that the accuracy of predictions from neural networks are essentially equivalent to results from conventional methods while other evaluations indicate that either method may be superior. Experience gained from these numerical experiments provide insight for improving the performance of neural networks relative to other methods for identifying parameters associated with experimental data. Neural networks may also be used in support of conventional algorithms by providing starting points for nonlinear minimization algorithms.

5449 (IEN–38/92) **Numerical nodal simulation of the axial power distribution within nuclear reactors using a kinetics diffusion model. I.** Barros, R.C. de. Instituto de Engenharia Nuclear (IEN), Rio de Janeiro, RJ (Brazil). May 1992. [95] (In Portuguese). Order Number DE93609445. Source: OSTI; NTIS (US Sales Only); INIS.

Presented here is a new numerical nodal method for the simulation of the axial power distribution within nuclear reactors using the one-dimensional one speed kinetics diffusion model with one group of delayed neutron precursors. Our method is based on a spectral analysis of the nodal kinetics equations. These equations are obtained by integrating the original kinetics equations separately over a time step and over a spatial node, and then considering flat approximations for the forward difference terms. These flat approximations are the only approximations that are considered in the method. As a result, the spectral nodal method for space - time reactor kinetics generates numerical solutions for space independent problems or for time independent problems that are completely free from truncation errors. We show numerical results to illustrate the method's accuracy for coarse mesh calculations. (author).

5450 (INIS-BR–2949) **Stability limits against flux oscillations due the presence of xenon 135.** Cunha Menezes Filho, A. da. Instituto Militar de Engenharia (IME), Rio de Janeiro, RJ (Brazil). 1975[68] (In Portuguese). Order Number DE93609446. Source: OSTI; NTIS (US Sales Only); INIS.

The flux oscillations due to the Xenon distribution in homogeneous thermal reactors are studied treating the space dependence through the modal expansion technique. The effect of the feedbacks due to Xenon and a power feedback coefficient on the linear stability of the reactor is investigated employing various number of terms in the modal expansion. Stability calculations are perform varying the reactor size in order to establish the size of the reactor which is unstable against spatial oscillations at the flux levels of the currently operating power reactors. (author).

5451 (KFK–5073) **Theory of neutron resonance cross sections for safety applications.** Froehner, F.H. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Nukleare Sicherheitsforschung. Sep 1992. 61p. (CONF-9202145–: Workshop on computation and analysis of nuclear data relevant to nuclear energy and safety, Miramare (Italy), 10 Feb - 13 mar 1992). Order Number DE93744882. Source: OSTI; NTIS (US Sales Only); INIS.

Neutron resonances exert a strong influence on the behaviour of nuclear reactors, especially on their response to the temperature changes accompanying power excursions, and also on the efficiency of shielding materials. The relevant theory of neutron resonance cross sections including the practically important approximations is reviewed, both for the resolved and the unresolved resonance region. Numerical techniques for Doppler broadening of resonances are presented, and the construction of group constants

and especially of self-shielding factors for neutronics calculations is outlined. (orig.).

5452 (WSRC-MS–92-028) **Enhancement of pool boiling from a vertical rod using guide disks.** Whitehouse, J.C. Westinghouse Savannah River Co., Aiken, SC (United States). [1992]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-9209172–3: 5. nuclear reactor thermal-hydraulics (NURETH) conference, Salt Lake City, UT (United States), 21-24 Sep 1992). Order Number DE93002690. Source: OSTI; NTIS; GPO Dep.

This report provides experimental and theoretical investigation of the boiling process which used a system of evenly spaced disks to constrain the path of bubbles from point origin to point of collapse. The experiments identified five distinct heat-transfer regimes, two of which (flange and strobe) are unique to this geometry and cannot be explained by conventional heat-transfer correlations. Bubble and wave models developed for flange and strobe boiling, respectively, predict these phenomena with reasonable success.

2202 Components and Accessories

Refer also to citation(s) 5350, 5618, 5636, 5651, 5657, 6689

5453 (ANL/MCT/TMS–1) **Flow-induced vibration: 1992.** Chen, S.S. Argonne National Lab., IL (United States). Materials and Components Technology Div. Sep 1992. 23p. Sponsored by Taiwan Power Co., Taipei (Taiwan, Province of China). DOE Contract W-31109-ENG-38. Contract 85540. Order Number DE93003191. Source: OSTI; NTIS; GPO Dep.

A joint program on flow-induced vibration (FIV) as established in July 1988 between Taiwan Power Company (Taipower or TPC) and ANL. The main objectives of the program are to provide a technology transfer program on FIV for Taipower staff and to assist Taipower with various aspects of FIV including evaluation of reports and proposals, review of designs, resolution of design issues, recommendation for design modifications, and selected research studies. During the first two years, the following tasks were accomplished: A technology transfer program on FIV was completed and key Taipower staff members were prepared to handle future problems in the subject area. The modified component cooling water (CCW) heat exchangers were assessed and the basis for a license from the Taiwan Atomic Energy Council (AEC) was established. The seismic reanalysis of Chin Shan spent-fuel racks was assessed and a report was submitted to the Taiwan AEC. Fluid/structure interaction activities were coordinated and provided a list of potential bidders for a fluid transient project and related publications and a recommendation for purchasing technical data on fluid coupling. Flow-induced vibration of tube arrays was reviewed and the needs of Taipower in the area of fluid/structure interaction were identified as were the procedures necessary for Taipower to accomplish its goals. A computer program, ARRAY, was established to compute the added-mass matrices for tube arrays. Taipower expressed interest in extending the joint program so that ANL could provide continuing assistance. The program was extended for several years (May 1, 1991, to June 30, 1994). Work from May 1, 1991, through June 30, 1992, summarized in this report, included technology transfer, assessment of sensing line and valve vibrations, literature survey, and tests on motion-dependent fluid forces acting on tube arrays in crossflow.

5454 (CONF-930116–8) **The Centralized Reliability Data Organization (CREDO): Past, present, and future.** Smith, M.S.; Drischler, J.D. Oak Ridge National Lab., TN (United States). [1992]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Probabilistic safety assessment international topical meeting; Clearwater Beach, FL (United States); 27-29 Jan 1993. Order Number DE93002831. Source: OSTI; NTIS; GPO Dep.

the Centralized Reliability Data Organization (CREDO) is a component-based data system and data analysis center jointly sponsored by DOE and the Power Reactor and Nuclear Fuel Development Corporation (PNC) of Japan. Efforts within CREDO are focused on reliability, availability, and maintainability (RAM) data and analyses for mechanical, electrical, and electronic components that were designed to function in liquid metal environments and their support systems. Data are currently received from a variety of sources, including DOE facilities and PNC facilities at 0-arai Engineering Center. Engineering, event, and operating data records are submitted by site staff for inclusion into the CREDO database. Engineering records provide detailed information on component design and operating parameters, abnormal or unusual occurrences are documented in the event reports, and facility operating status is provided in the operating report. Event rates on individual components or subpopulations may be calculated. In addition to data collection, CREDO staff disseminate RAM data and publish analyses of their findings. Results from two recent analyses are summarized: a journal article on large sodium circulation pumps and a paper on motor-operated globe valve performance. Funding for continued data collection has not been committed for FY1 993. A proposal to shift the CREDO database management system from a mainframe computer to a PC-based system has been supported by DOE. Under this proposal, the entire contents of the database will be distributed directly to approved members of the LMR community.

5455 (EGG-NTAP–6175) **Inservice leak testing of primary pressure isolation valves: Final report.** Livingston, R.A. EG and G Idaho, Inc., Idaho Falls, ID (United States). Feb 1983. 150p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93003077. Source: OSTI; NTIS; GPO Dep.

This report discusses the inservice leak testing of primary pressure isolation valves in commercial power reactors which was investigated to identify problems with current test procedures and requirements. Nine utilities were surveyed to gather information which is presented in this report. An analysis of the survey information was performed, resulting in recommended changes to improve valve leak testing requirements currently invoked by Section XI of the ASME Boiler and Pressure Vessel Code, Plant Technical Specifications, and Regulatory Guides addressing this subject.

5456 (IA–1471, pp. 28) **A two-fluid model for critical flashing flows in pipes.** Dagan, R.; Elias, E.; Wachholder, E.; Olek, S. Israel Atomic Energy Commission, Tel Aviv (Israel). Aug 1992. In *Research laboratories annual report 1991.* [247] Order Number DE93609217. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. FLOW MODELS/two-phase flow; HEAT TRANSFER; LIQUID FLOW; MASS TRANSFER; REACTOR COOLING SYSTEMS

5457 (IAEA-TECDOC–665, pp. 53-58) **Dynamic strain ageing effect on fracture toughness of vessel steels.** Kim, I.S. (Korea Advanced Inst. of Science and Technology, Seoul (Korea, Republic of)). International Atomic Energy Agency, Vienna (Austria). Sep 1992. (CONF-9105343–: IAEA-Technical Committee meeting on materials for advanced water-cooled reactors, Plzen (Czechoslovakia), 14-17 May 1991). In *Materials for advanced water cooled reactors: Proceedings of a technical committee meeting held in Plzen Czechoslovakia, 14-17 May 1991.* [163] Order Number DE93609447. Source: OSTI; NTIS (US Sales Only); INIS.

The effect of dynamic strain ageing (DSA) on fracture was investigated on the quenched and tempered specimens of ASME SA508-Class3 nuclear pressure vessel steel. Serrated flow by DSA was observed between 180-340 deg. C at tensile strain rate of $2.08X10^{-4}$/sec and $1.25X10^{-3}$/sec. DSA caused a sharp rise in the ultimate tensile strength and a marked decrease in ductility. The DSA range shifted to higher temperature with increased strain rates. The temperature and strain rate dependence on the onset of serrations yielded an activation energy of 16.2Kcal/mol, which suggests that the process is controlled by interstitial diffusion of carbon and nitrogen in ferrite. By direct current potential drop (DCPD) method Ji value, that is for true crack initiation, was measured to be lowered by DSA. The drop in Ji at the elevated temperatures may be due to the interaction of the interstitial impurities with dislocations at the crack front. Comparing to JIC by ASTM E813, the Ji by DCPD was more sensitive to detect the crack initiation. Crack propagation was also affected in terms of tearing modulus. The tearing modulus in the dynamic strain ageing was about 30% smaller than that at room temperature. (author). 21 refs, 5 figs, 2 tabs.

5458 (IAEA-TECDOC–665, pp. 58-67) **Fracture toughness of shape welded material type ASTM A 533, Grade B, class 1.** Iorio, A.F. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)); Crespi, J.C.; Hameedullah, M. International Atomic Energy Agency, Vienna (Austria). Sep 1992. (CONF-9105343–: IAEA-Technical Committee meeting on materials for advanced water-cooled reactors, Plzen (Czechoslovakia), 14-17 May 1991). In *Materials for advanced water cooled reactors: Proceedings of a technical committee meeting held in Plzen Czechoslovakia, 14-17 May 1991.* [163] Order Number DE93609447. Source: OSTI; NTIS (US Sales Only); INIS.

The purpose of the present study was to determine Elastic-Plastic fracture toughness (J_{Ic}) of a shape-welded material type: ASTM A 533 Grade B, class 1. Multispecimen J-integral Resistance curves were developed at room temperature for 38 mm thick compact tension (CT) specimens with a/w of 0.6 and 20 % side-grooving. The results obtained from the valid data are in agreement with J_{Ic} values for such type of materials. However, fatigue crack propagation curves indicated some anisotropy in the CL and LC orientations of the specimens. Tearing modulus values were found comparatively quite low, which is probably due to excessive amounts of nickel, manganese and oxygen in the material. (author). 13 refs, 8 figs, 2 tabs.

5459 (IAEA-TECDOC–665, pp. 67-71) **The corrosion effect of primary coolant on the base metal and heat affected zone of the reactor pressure vessel inner wall.** Splichal, K. (Ustav Jadermeho Vyzkumu CSKAE, Rez (Czechoslovakia)); Ruscak, M.; Chvatal, P.; Zdarek, J. International Atomic Energy Agency, Vienna (Austria). Sep 1992. (CONF-9105343–: IAEA-Technical Committee meeting on materials for advanced water-cooled reactors, Plzen (Czechoslovakia), 14-17 May 1991). In *Materials for advanced water cooled reactors: Proceedings of a technical committee meeting held in Plzen Czechoslovakia, 14-17 May 1991.* [163] Order Number DE93609447. Source: OSTI; NTIS (US Sales Only); INIS.

The operation reliability as well as service life of nuclear power plant components is affected by corrosion damage of materials. Our research in this field includes: 1/Steels for reactor core. 2/ Reactor pressure vessel materials. The basic attention has been devoted to the combined effect of both corrosive environment and radiation on the subcritical crack growth under both static and cyclic strain loading of light-water reactor materials. With other components of the primary and secondary circuits, other effects of corrosion damage such as pitting corrosion and intergranular attack are also investigated together with the evaluation of defects growth up to a critical size. (author). 5 figs.

5460 (NUREG/CR–5793) **A comparison of analysis methodologies for predicting cleavage arrest of a deep crack in a reactor pressure vessel subjected to pressurized-thermal-shock loading conditions.** Keeney-Walker, J. (Oak Ridge National Lab., TN (United States)); Bass, B.R. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Oak Ridge National Lab., TN (United States). Sep 1992. 26p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. (ORNL/TM–11969). Source: OSTI; NTIS; INIS; GPO.

Several calculational procedures are compared for predicting cleavage arrest of a deep crack in the wall of a prototypical reactor pressure vessel (RPV) subjected to pressurized-thermal-shock (PTS) types of loading conditions. Three procedures examined in this study used the following models: (1) a static finite-element model (full bending); (2) a radially constrained static model; and (3) a thermoelastic dynamic finite-element model. A PTS transient loading condition was selected that produced a deep arrest of an axially oriented, initially shallow crack according to calculational results obtained from the static (full-bending) model. Results from the two static models were compared with those generated from the detailed thermoelastic dynamic finite-element analysis. The dynamic analyses modeled cleavage-crack propagation using a node-release technique and application- and generation-mode methodologies. Comparisons presented here indicate that the degree to which dynamic solutions can be approximated by static models is highly dependent on several factors, including the material dynamic fracture curves and the propensity for cleavage reinitiation of the arrested crack under PTS loading conditions. Additional work is required to develop and validate a satisfactory dynamic fracture toughness model applicable to postcleavage arrest conditions in an RPV.

5461 (NUREG/CR–5913-Vol.2) **Irradiation effects on fracture toughness of two high-copper submerged-arc welds, HSSI series 5: Volume 2, Appendices E and F.** Nanstad, R.K. (Oak Ridge National Lab., TN (United States)); Haggag, F.M.; McCabe, D.E.; Iskander, S.K.; Bowman, K.O.; Menke, B.H. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Oak Ridge National Lab., TN (United States). Oct 1992. 620p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. (ORNL/TM–12156/V2). Source: OSTI; NTIS; INIS; GPO.

The Fifth Irradiation Series in the Heavy-Section Steel irradiation (HSSI) Program was aimed at obtaining a statistically significant fracture toughness data base on two weldments with high-copper contents to determine the shift and shape of the K_{Ic} curve as a consequence of irradiation. The program included irradiated Charpy V-notch impact, tensile, and drop-weight specimens in addition to compact fracture toughness specimens. Compact specimens with thicknesses of 25.4, 50.8, and 101.6 mm [1T C(T), 2T C(T), and 4T C(T), respectively] were irradiated. Additionally, unirradiated 6T C(T) and 8T C(T) specimens with the same K_{Ic} measuring capacity as the irradiated specimens were tested. The materials for this irradiation series were two weldments fabricated from special heats of weld wire with copper added to the melt. One lot of Linde 0124 flux was used for all the welds. Copper levels for the two welds are 0.23 and 0.31 wt %, while the nickel contents for both welds are 0.60 wt %. Twelve capsules of specimens were irradiated in the pool-side facility of the Oak Ridge Research Reactor at a nominal temperature of 288°C and an average fluence of about 1.5×10^{19} neutrons/cm^2 (> 1 MeV). This volume, Appendices E and F, contains the load-displacement curves and photographs of the fracture toughness specimens from the 72W weld (0.23 wt % Cu) and the 73 W weld (0.31 wt % Cu), respectively.

5462 (NUREG/CR–5915) **Finite-length surface crack propagation in clad cylinders.** Keeney-Walker, J. (Oak Ridge National Lab., TN (United States)); Merkle, J.G.; Iskander, S.K.; Dickson, T.L. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Oak Ridge National Lab., TN (United States). Nov 1992. 32p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. (ORNL/TM–12166). Source: OSTI; NTIS; INIS; GPO.

Licensing issues within the nuclear industry dictate a need to investigate the effects of cladding on the extension of small finite-length cracks near the inside surface of a vessel. Limited experimental data and analyses indicate that cladding can inhibit the propagation of certain shallow flaws. This report describes an analytical study which was carried out to determine (1) the minimum flaw depth for crack initiation under PTS loading for semicircular surface flaws in a clad reactor pressure vessel and (2) the impact, in terms of the conditional probability of vessel failure, of using a semicircular surface flaw as the initial flaw. The analytical results indicate that, for initiation, a much deeper critical crack depth is required for the finite-length flaw than for the infinite-length flaw. Probabilistic analysis of selected PTS transients produced a substantial in the conditional probability of failure for a finite-length flaw model. It is recommended that a testing program be carried out utilizing clad cruciform and clad cylindrical test specimens. The completed experimental and analytical research will provide a basis for introducing a refined treatment of surface flaw initial geometry into PTS fracture analysis procedures. This report is designated HSST Report 129.

2203 Fuel Elements

Refer also to citation(s) 5080, 5489, 5512, 5587, 5588, 5589, 5605, 7463

5463 (FEI–2108) **Calculational-experimental determination of fuel can temperature in the BN type reactors using the**

large-scale profilometry data. Sopov, O.V.; Kireev, M.G. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (Russian Federation). Fiziko-Ehnergeticheskij Inst. 1990. [10] (In Russian). Order Number DE93609451. Source: OSTI; NTIS (US Sales Only); INIS.

A method for evaluation of fuel can temperature using the large-scale profilometry data based on the inverse problem solution, is developed. Temperature values, which can explain the values of can diameter measured in post-reactor analysis, are determined. It is assumed that relative distribution of neutron flux is known exactly. Parameters of the shape change model are calculated on the basis of the same profilometric data. Sufficiently iteration character of these calculations is taken into account. Orthogonal Tchebyshev polinomials are used for description of dose-temperature dependence of shape change. A special selection of fuel elements is conducted by means of their grouping according to can diameter by the method of k-averages of cluster analysis, when the matrix for calculating the parameters of this dependence is formed. 4 refs.; 1 fig.

5464 (JAERI-M–92-118) **Migration behavior of palladium in UO_2, (3).** Yoneyama, Mitsuru (Hokkaido Univ., Sapporo (Japan)); Sato, Seichi; Ohashi, Hiroshi; Ogawa, Toru; Ito, Akinori; Fukuda, Kousaku. Japan Atomic Energy Research Inst., Tokyo (Japan). Aug 1992. 55p. (In Japanese). Order Number DE93754309. Source: OSTI; NTIS; INIS.

Palladium (Pd) is easily released from UO_2 kernels in HTGR coated fuel particles, and reacts with SiC coating layer. In addition, Pd is one of metallic fission products in irradiation UO_2, which constitutes in dissoluble residue in reprocessing of LWR fuels. In the present investigation, the migration of palladium in UO_2 was examined by heating diffusion pairs sandwiched Pd foil between UO_2 wafers at 1300 $\approx$ 1800degC. Experiments were also carried out on affinity of Pd to UP_2 and a formation of U-Pd alloy. Pd was found mainly in the pores of UO_2. The maximum depth intruded by Pd in fairly large amount was more than 100 μm for UO_2 with 90%TD and 50μm for UO_2 with 95%TD, while the maximum length of open pores was 330 μm for UO_2 with 90%TD, and 50 m for that with 95%TD. Fused Pd wetted UO_2 very much. Pd intruded deeply into UO_2, especially in the edge of Pd droplet. Furthermore, U was detected either in precipitates or the Pd source with α-Pd phase of U-Pd alloy containing Pd at about 10at%. This fact indicates that Pd highly reacts with UO_2. From the above results, the transport of Pd in UO_2 was explained by the model of gaseous diffusion through pores in UO_2, which is retarded by formation of U-Pd alloy. It is also indicated that UPd_3 forms even at the oxygen potential condition of O/U ratio, which is a little higher than 2.00 on the basis of thermodynamic calculation. (author).

2204 Control Systems

Refer also to citation(s) 5492, 5536, 5539, 5606, 5609, 5611, 5613, 5663

5465 (CONF-890634–5) **Tutorial: Neural networks and their potential application in nuclear power plants.** Uhrig, R.E. (Tennessee Univ., Knoxville, TN (United States). Dept. of Nuclear Engineering). Tennessee Univ., Knoxville, TN (United States). Dept. of Nuclear Engineering. [1989]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG07-88ER12824. From Expert systems applications for the electric power industry conference; Orlando, FL (United States); 5-8 Jun 1989. Order Number DE93002120. Source: OSTI; NTIS; GPO Dep.

A neural network is a data processing system consisting of a number of simple, highly interconnected processing elements in an architecture inspired by the structure of the cerebral cortex portion of the brain. Hence, neural networks are often capable of doing things which humans or animals do well but which conventional computers often do poorly. Neural networks have emerged in the past few years as an area of unusual opportunity for research, development and application to a variety of real world problems. Indeed, neural networks exhibit characteristics and capabilities not provided by any other technology. Examples include reading Japanese Kanji characters and human handwriting, reading a typewritten manuscript aloud, compensating for alignment errors in robots, interpreting very "noise" signals (e.g. electroencephalograms), modeling complex systems that cannot be modelled mathematically, and predicting whether proposed loans will be good or fail. This paper presents a brief tutorial on neural networks and describes research on the potential applications to nuclear power plants.

5466 (CONF-9007253–1) **Applications of neural networks to monitoring and decision making in the operation of nuclear power plants: Summary.** Uhrig, R.E. (Tennessee Univ., Knoxville, TN (United States)). Tennessee Univ., Knoxville, TN (United States). [1990]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG07-88ER12824. From International Neural Network Society meeting; Paris (France); 9-13 Jul 1990. Order Number DE93002126. Source: OSTI; NTIS; INIS; GPO Dep.

Application of neural networks to monitoring and decision making in the operation of nuclear power plants is being investigated under a US Department of Energy sponsored program at the University of Tennessee. Projects include the feasibility of using neural networks for the following tasks: (1) diagnosing specific abnormal conditions or problems in nuclear power plants, (2) detection of the change of mode of operation of the plant, (3) validating signals coming from detectors, (4) review of "noise" data from TVA's Sequoyah Nuclear Power Plant, and (5) examination of the NRC's database of "Letter Event Reports" for correlation of sequences of events in the reported incidents. Each of these projects and its status are described briefly in this paper. This broad based program has as its objective the definition of the state-of-the-art in using neural networks to enhance the performance of commercial nuclear power plants.

5467 (CONF-9011312–1) **Expert system driven fuzzy control application to power reactors.** Tsoukalas, L.H.; Berkan, R.C.; Upadhyaya, B.R.; Uhrig, R.E. Tennessee Univ., Knoxville, TN (United States). Dept. of Nuclear Engineering. [1990]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG07-88ER12824. From 2. international conference on tools for artificial intelligence; Washington, DC (United States); 6-9 Nov 1990. Order Number DE93002121. Source: OSTI; NTIS; INIS; GPO Dep.

For the purpose of nonlinear control and uncertainty/imprecision handling, fuzzy controllers have recently reached acclaim and increasing commercial application. The fuzzy control algorithms often require a "supervisory" routine that provides necessary heuristics for interface, adaptation, mode selection and other implementation issues. Performance characteristics of an on-line fuzzy controller depend strictly on the ability of such supervisory routines to manipulate the fuzzy control algorithm and enhance its control capabilities. This paper describes an expert system driven fuzzy control design application to nuclear reactor control, for the automated start-up control of the Experimental Breeder Reactor-II. The methodology is verified through computer simulations using a valid nonlinear model. The necessary heuristic decisions are identified that are vitally important for the implemention of fuzzy control in the actual plant. An expert system structure incorporating the necessary supervisory routines is discussed. The discussion also includes the possibility of synthesizing the fuzzy, exact and combined reasoning to include both inexact concepts, uncertainty and fuzziness, within the same environment.

5468 (CONF-9104287–2) **Real-time distributed simulation using the Modular Modeling System interfaced to a Bailey NETWORK 90 system.** Edwards, R.M. (Pennsylvania State Univ., University Park, PA (United States). Dept. of Nuclear Engineering); Turso, J.A.; Garcia, H.E.; Ghie, M.H.; Dharap, S.; Lee, S. Pennsylvania State Univ., University Park, PA (United States). Dept. of Nuclear Engineering. [1991]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-89ER12889. From 1991 EPRI conference on power plant and power system training, simulators, and modeling; Miami, FL (United States); 17-19 Apr 1991. Order Number DE93003196. Source: OSTI; NTIS; INIS; GPO Dep.

The Modular Modeling System was adapted for real-time simulation testing of diagnostic expert systems in 1987. The early approach utilized an available general purpose mainframe computer which operated the simulation and diagnostic program in the multitasking environment of the mainframe. That research program was subsequently expanded to intelligent distributed control applications incorporating microprocessor based controllers with the aid

of an equipment grant from the National Science Foundation (NSF). The Bailey NETWORK 90 microprocessor-based control system, acquired with the NSF grant, has been operational since April of 1990 and has been interfaced to both VAX mainframe and PC simulations of power plant processes in order to test and demonstrate advanced control and diagnostic concepts. This paper discusses the variety of techniques that have been used and which are under development to interface simulations and other distributed control functions to the Penn State Bailey system.

5469 (CONF-9109110–10) **Hybrid digital signal processing and neural networks applications in PWRs.** Eryurek, E.; Upadhyaya, B.R.; Kavaklioglu, K. Tennessee Univ., Knoxville, TN (United States). Dept. of Nuclear Engineering. [1991]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG07-88ER12824. From International conference on frontiers in innovative computing for the nuclear industry; Jackson, WY (United States); 15-18 Sep 1991. Order Number DE93003561. Source: OSTI; NTIS; INIS; GPO Dep.

Signal validation and plant subsystem tracking in power and process industries require the prediction of one or more state variables. Both heteroassociative and auotassociative neural networks were applied for characterizing relationships among sets of signals. A multi-layer neural network paradigm was applied for sensor and process monitoring in a Pressurized Water Reactor (PWR). This nonlinear interpolation technique was found to be very effective for these applications.

5470 (DOE/ER/12824–1) **Enhancing nuclear power plant performance through the use of artifical intelligence: First annual report.** Johnson, M.; Maren, A.; Miller, L.; Uhrig, R.; Upadhyaya, B. Tennessee Univ., Knoxville, TN (United States). Dept. of Nuclear Engineering. 15 Jun 1989. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG07-88ER12824. Order Number DE93001622. Source: OSTI; NTIS; GPO Dep.

In the summer of 1988, the Department of Nuclear Engineering (NE) at the University of Tennessee (UT) in Knoxville was selected to carry out a research program in "Enhancing the Operation of Nuclear Power plants through the use of Artificial Intelligence, This program is sponsored by the Department of Energy's Office of Energy Research under 10CFR605 for Nuclear Engineering Research. The objective of the research is to advance the state-of-the-art of nuclear power plant control, safety, management, and instrumentation systems through the use of artificial intelligence (AI) techniques, including both expert systems and neural networks. The emphasis will be placed on methods that can be implemented on a rapid or real-time basis. A second, but equally important, objective is to build a broadly based critical mass of expertise in the artificial intelligence, field that can be brought to bear on the technology of nuclear power plants. Both of these goals are being met. This overview and the attached technical reports describe the work that is being carried out. Although in some cases, the scope of the work differs somewhat from the specific tasks described in the original proposal, all activities are clearly within the overall scope of the contract.

5471 (DOE/ER/12889–14) **Intelligent distributed control for nuclear power plants: Second annual technical progress report, September 1990–September 1991.** Klevans, E.H.; Edwards, R.M.; Ray, A.; Lee, K.Y.; Garcia, H.E.: Chavez, C.M.; Turso, J.A.; BenAbdennour, A. Pennsylvania State Univ., University Park, PA (United States). Coll. of Engineering. [1991]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-89ER12889. Order Number DE93003082. Source: OSTI; NTIS; INIS; GPO Dep.

In September of 1989 work began on the DOE University Program grant DE-FG07-89ER12889. The grant provides support for a three year project to develop and demonstrate Intelligent Distributed Control (IDC) for Nuclear Power Plants. The body of this Second Annual Technical Progress report covers the period from September 1990 to September 1991. It summarizes the second year accomplishments while the appendices provide detailed information presented at conference meetings. These are two primary goals of this research. The first is to combine diagnostics and control to achieve a highly automated power plant as described by M.A. Schultz, a project consultant during the first year of the project. This philosophy, as presented in the first annual technical progress report, is to improve public perception of the safety of nuclear power plants by incorporating a high degree automation where greatly simplified operator control console minimizes the possibility of human error in power plant operations. A hierarchically distributed control system with automated responses to plant upset conditions is the focus of our research to achieve this goal. The second goal is to apply this research to develop a prototype demonstration on an actual power plant system, the EBR-II steam plant.

5472 (DOE/ER/12930–1) **Studies on the closed-loop digital control of multi-modular reactors: Final report.** Bernard, J.A. (Massachusetts Inst. of Tech., Cambridge, MA (United States). Nuclear Reactor Lab.); Henry, A.F.; Lanning, D.D.; Meyer, J.E. Massachusetts Inst. of Tech., Cambridge, MA (United States). Nuclear Reactor Lab. Nov 1992. 334p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER12930. (MITNRL–049). Order Number DE93004605. Source: OSTI; NTIS; INIS; GPO Dep.

This report describes the theoretical development and the evaluation via both experiment and simulation of digital methods for the closed-loop control of power, temperature, and steam generator level in multi-modular reactors. The major conclusion of the research reported here is that the technology is currently available to automate many aspects of the operation of multi-modular plants. This will in turn minimize the number of required personnel and thus contain both operating and personnel costs, allow each module to be operated at a different power level thereby staggering the times at which refuelings would be needed, and maintain the competitiveness of US industry relative to foreign vendors who are developing and applying advanced control concepts. The technology described in this report is appropriate to the proposed multi-modular reactor designs and to present-generation pressurized water reactors. Its extension to boiling water reactors is possible provided that the commitment is made to create a real-time model of a BWR. The work reported here was performed by the Massachusetts Institute of Technology (MIT) under contract to the Oak Ridge National Laboratory (ORNL) and to the United States Department of Energy (Division of Industry and University Programs, Contract No. DE-FG07-90ER12930.)

5473 (DOE/NE/37964–1) **Methods for the computerized control of nuclear power plants for improved safety, quality, and productivity: Final report.** Heising, C.D. Northeastern Univ., Boston, MA (United States). Dec 1988. 309p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-86NE37964. Order Number DE93005044. Source: OSTI; NTIS; INIS; GPO Dep.

The purpose of this research project was to translate the Total Quality Control (TQC) management system to the operation of nuclear power plants. This work began on September 30, 1986 and continued through December 30, 1988 at an original funding level of $251,000. Four graduate research assistants were employed during the two year project period, with all four completing master's level degree theses or projects. In addition, several papers were presented at technical conferences regarding this work. Currently, one paper has been accepted for publication in the journal of Operations Research, and two more papers are currently being written for submission in the near future. The project also received favorable publicity at the university and elsewhere. The major findings of this work was that, indeed, the Japanese management system of Total Quality Control (TQC) may be applied to nuclear power plant operation to achieve enhanced safety and increased efficiency. Two utilities are already heavily engaged in implementing TQC at their nuclear power plants: the Kansai Electric Company of Osaka, Japan and the Florida Power and Light Company of Miami, Florida. We have documented in detail the progress of these utilities in their attempts to implement TQC, as well as highlighting "success stories" of TQC implementation in other industries.

5474 (DPW–5430) **Control and safety rod actuator test procedure NYX operations.** McGinnis, P.R. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). 21 May 1952. 8p. Sponsored by USDOE, Washington, DC (United States).

DOE Contract AC09-76SR00001. (SR/H–229). Order Number DE93001462. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report is intended to provide NYX operating personnel with general instructions for operation and preliminary testing of the reactor control and safety rod systems. It is expected that additional testing will be required at the completion of the procedure outlined here for the purpose of providing more definite proof of the acceptable operability of the system. Such a future test program would be based on the performance of the equipment as determined by following this outline and would include tests of the repeatability of performance and wearing qualities of the actuators. The tests outlined in this report are designed to indicate whether or not the system will perform the functions outlined in the Benifications and requirements, and to enable personnel to become familiar with the design and operation of the system.

5475 (HW–7-4167) **Production Test No. 105-51-P Supplement A, Pneumatic test of vertical thimbles: Final report.** Switzer, W.O. Hanford Atomic Products Operation, Richland, WA (United States). 29 May 1946. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003392. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Short communication. HANFORD PRODUCTION REACTORS/ control elements; PROGRESS REPORT; TESTING; PNEUMATICS; LEAKS

5476 (HW–27331) **Production Test No. 105-530-A, Supplement B: New methods of fabricating horizontal control rods.** Hulin, M.W. Hanford Atomic Products Operation, Richland, WA (United States). 6 Mar 1953. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003432. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This memorandum discusses procedures to test new methods of bonding boron to aluminum tubing in the fabrication of horizontal control rods.

5477 (HW–38071) **Development Test No. 105-609-A: Test of the prototype gamma monitor slug rupture detection equipment at 105-C.** Paul, R.S.; Greene, M.C. Hanford Works, Richland, WA (United States). 15 Jul 1955. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003408. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document describes test procedures for testing of the prototype gamma monitor slug rupture detection equipment at 105-C.

5478 (HW–38221) **Final report: Pile technology Development Test 105-571-A: Molded ribbed sphincter seal and seal leakage test for the "C" horizontal rod.** Jackson, P.M. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 20 Jul 1955. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003409. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Since 105-C Pile was designed without thimbles, gas seals are required on all horizontal control rods to prevent the pile gases from escaping and contaminating the atmosphere.

5479 (HW–43140) **Final report: Development Test No. 105-609-A: Slug rupture detection experiments at 105-C.** Paul, R.S. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 16 Apr 1956. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003410. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report details the evaluation of the prototype Gamma Monitor system which demonstrated more sensitivity for rupture detection than the C Beta Monitor in agreement with earlier tests at H pile. In one instance a rupture was indicated several hours earlier by the experimental gamma installation.

5480 (HW–47150) **C-Reactor I and E loading instability limits.** Hess, K.W. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 24 Jan 1957. 54p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003934. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The pilot charging of I & E fuel elements has been implemented at C-Reactor under Production Test IP-19-A. It was necessary to provide adequate tube protection against flow interruption by establishing proper trip setting on the Panellit pressure gauges. the administration of these Panellit trip settings is done by trip-before-boiling tube outlet temperature limits, which are similar in principle to the current instability limits. Trip-before-boiling limits for C-Reactor I & E fuel elements loadings are presented in this document.

5481 (HW–66858-RD-2) **Analog to digital converter system for temperature monitoring – B, C, D, DR, F, and H reactors.** Ballowe, J.W. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 23 Mar 1961. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003527. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document discusses a proposal that certain presently installed reactor process water outlet temperature data logging equipment in subject reactors to be replaced with new functionally simplified equipment of a more adequate design. The primary purpose of the proposed installation is to replace existing equipment which is obsolete and in three reactors is worn out to the point where the equipment is out of service frequently for periods of time up to 8 hours or more. The new equipment will provide reliable process tube temperature information for use in the functions of reactor control and product accountability. Based upon anticipated incremental production gains resulting from use of the new equipment, the amortization period for the project is calculated at 2.7 years.

5482 (NUREG–1431-Vol.2) **Standard Technical Specifications, Westinghouse Plants: Volume 2, Bases (Sections 2.0–3.3).** Nuclear Regulatory Commission, Washington, DC (United States). Div. of Operational Events Assessment. Sep 1992. 327p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This NUREG contains improved Standard Technical Specifications (STS) for Westinghouse Plants and documents the positions of the Nuclear Regulatory Commission based on the Westinghouse Owners Group's proposed STS. This document is the result of extensive technical meetings and discussions among the NRC staff, the Nuclear Steam Supply System (NSSS) Owners Groups, the NSSS vendors, and the Nuclear Management and Resources Council (NUMARC). The improved STS were developed based on the criteria in the interim Commission Policy Statement on Technical Specification Improvements for Nuclear Power Reactors, dated February 6, 1987. The improved STS will be used as the basis for individual nuclear power plant licensees to develop improved plant-specific technical specifications. This report contains three volumes. Volume 1 contains the Specifications for all chapters and sections of the improved STS. Volume 2 contains the Bases for Chapters 2.0 and 3.0, and Sections 3.1–3.3 of the unproved STS. Volume 3 contains the Bases for Sections 3.4–3.9 of the improved STS which contain information on safety limits, reactivity control systems, power distribution limits, and instrumentation.

2205 Environmental Aspects

Refer also to citation(s) 5612, 5652, 6676

5483 (CONF-930116–10) **Hand-calculation technique for the evaluation of public risk from a severe accident at a nuclear power plant.** Linn, M.A.; Schmoyer, R.E. Oak Ridge National Lab., TN (United States). [1993]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Probabilistic safety assessment international topical meeting (PSA 93); Clearwater Beach, FL (United States); 27-29 Jan 1993. Order Number DE93003023. Source: OSTI; NTIS; INIS; GPO Dep.

The Nuclear Regulatory Commission (NRC) is in the process of promulgating a proposed rule 10 CFR Part 54, "Requirements for Renewal of Operating Licensees for Nuclear Power Plants," which will allow licenses to renew the operating licenses on their nuclear power plants for an additional 20 years beyond the original 40-year

limit. A Generic Environmental Impact Statement (GEIS) prepared by the Oak Ridge National Laboratory (ORNL) in conjunction with and for the Nuclear Regulatory Commission to assess the environmental issues associated with this proposed rule. The evaluation of the environmental impact from postulated severe accidents was included in the GEIS. During this evaluation of postulated severe accidents, a method was developed to estimate the public health consequences of atmospheric releases from severe accidents that is much simpler to use than existing consequence computer codes. From the results of this work, it is concluded that the simplified methodology does provide reasonable and conservative estimates of public risk from atmospheric releases from severe accidents.

5484 (FOA-D–20177-4.3) **Field gamma ray spectrometry and soil sample measurements in Sweden following the Chernobyl accident. A data report.** Arntsing, R.; Bjurman, B.; De Geer, L.E.; Edvarson, K.; Finck, R.; Jakobsson, S.; Vintersved, I. National Defence Research Establishment, Sundbyberg (Sweden). Dec 1991. [26] Order Number DE93609203. Source: OSTI; NTIS; INIS.

The airborne radioactive material from the Chernobyl accident reached Sweden on 27 April 1986. In situ measurements were started by the Nuclear Detection Group of the National Defence Research Establishment (FOA 212) on 28 April 1986. Two high-resolution gamma-spectrometric systems were available for the project and it was decided to use one for mobile measurements in order to cove the affected part of Sweden whereas the other was used to follow the rate of change at one location in the Stockholm area. The radioactive deposition in Sweden mainly occurred in two periods, the first from 27th to 29th of April and the second from the 7th to 10th of May. In the first period the most affected regions were the eastern and central parts of Sweden, in particular the wet-deposition area along the coast of the Gulf of Bothnia and westwards to the mountain regions in Northern Sweden. During the second period, the deposition levels were much lower and mainly affecting the Southern and Southwestern parts of Sweden. Some results of the in situ and soil gamma measurements have been reported earlier (Edvarson 1989, 1991). In this report the results from measurement in the years 1986 to 1988 are reported. (au).

5485 (HW–32958-RD) **Reactor Section, Radiation Monitoring Sub-Section monthly report, August 1954.** Jerman, P.C. Hanford Atomic Products Operation, Richland, WA (United States). 3 Sep 1954. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93001730. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report details the activities of the Radiation Monitoring Sub-Section of the Reactor Section during the month of August 1954.

5486 (HW–57185-RD) **Existing Reactor Containment Program.** Rogers, G.J.; Heacock, H.W. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Aug 1958. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003520. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document responds to a request made for preliminary data on those engineering and study items to be included in the scope of work covered by Project CG-791, "Confinement of Radioactive Particulate Matter in 105 Buildings Exhaust Air". The results are presented.

5487 (INIS-mf–13396) **Calculating of radiation doses in rutinary unloads of liquid wastes from Laguna Verde nuclear power plant.** Molina, G. Instituto Politecnico Nacional, Mexico City (Mexico). Escuela Superior de Fisica y Matematicas. 1985[138] (In Spanish). Order Number DE93609204. Source: OSTI; NTIS (US Sales Only); INIS.

Utilization of nuclear energy to generate electricity is increasingly being used to replace fossil fuels. During operation of nuclear power plants, radioactive materials are produced, a small fraction of which are released to environment as liquid or gaseous effluents. Estimation of radiation doses caused by effluents release has three purposes. During design phase of a nuclear station it is useful to adapt the wastes treatment systems to acceptable limits. During licensing phase, the regulator organism verifies the design of nuclear station effectuating estimation of doses. Finally, during operation, before every unload of radioactive effluents, radiation doses should be evaluated in order to fulfill technical specifications limiting the release of radioactive materials to environment. 1. To perform calculations of individual doses due to liquid radioactive effluents unload in units 1 and 2 of Laguna Verde nuclear power plant (In licensing phase). 2. To perform a parametric study of the effect of unload recirculation over individual dose, since recirculation has two principal effects: thermodynamical effects in nuclear station and radioactivity concentration; the last can affect the fullfilment of dose limits. 3. To perform the calculation of collective doses causes by unloads of liquid effluents within a radius of 80 km of the plant caused by unload of liquid radioactive effluents during normal operation and does not include doses during accident conditions. In Mexico the organism in charge of regulation of peaceful uses of nuclear energy is Comision Nacional de Seguridad Nuclear y Salvaguardias (CNSNS) and for Laguna Verde licensing, the regulations of the country who manufactured the reactor (USA). In Appendix C, units are explained.

5488 (RAMA-III–89-04) **Containment severe accident thermohydraulic phenomena.** Frid, W. (Swedish Nuclear Power Inspectorate, Stockholm (Sweden)). Swedish Nuclear Power Inspectorate, Stockholm (Sweden); Swedish Radiation Protection Inst., Stockholm (Sweden); Swedish State Power Board, Vaellingby (Sweden); Oskarshamnsverkets Kraftgrupp AB, Stockholm (Sweden); Sydkraft AB, Malmoe (Sweden). Aug 1991. [151] Order Number DE93609206. Source: OSTI; NTIS; INIS.

This report describes and discusses the containment accident progression and the important severe accident containment thermohydraulic phenomena. The overall objective of the report is to provide a rather detailed presentation of the present status of phenomenological knowledge, including an account of relevant experimental investigations and to discuss, to some extent, the modelling approach used in the MAAP 3.0 computer code. The MAAP code has been used in Sweden as the main tool in the analysis of severe accidents. The dependence of the containment accident progression and containment phenomena on the initial conditions, which in turn are heavily dependent on the in-vessel accident progression and phenomena as well as associated uncertainties, is emphasized. The report is in three parts dealing with: * Swedish reactor containments, the severe accident mitigation programme in Sweden and containment accident progression in Swedish PWRs and BWRs as predicted by the MAAP 3.0 code. * Key non-energetic ex-vessel phenomena (melt fragmentation in water, melt quenching and coolability, core-concrete interaction and high temperature in containment). * Early containment threats due to energetic events (hydrogen combustion, high pressure melt ejection and direct containment heating, and ex-vessel steam explosions). The report concludes that our understanding of the containment severe accident progression and phenomena has improved very significantly over the parts ten years and, thereby, our ability to assess containment threats, to quantify uncertainties, and to interpret the results of experiments and computer code calculations have also increased. (au).

2206 Research, Test, Training, Production, Irradiation, Materials Testing Reactors

Refer also to citation(s) 5068, 5070, 5071, 5072, 5073, 5074, 5075, 5076, 5077, 5078, 5079, 5080, 5081, 5082, 5083, 5084, 5085, 5086, 5093, 5142, 5167, 5422, 5427, 5429, 5430, 5471, 5472, 5474, 5475, 5476, 5477, 5478, 5479, 5480, 5481, 5485, 5486, 5605, 5613, 5614, 5616, 5617, 5618, 5623, 5624, 5626, 5627, 5659, 5660, 5661, 5662, 5663, 6098, 7290, 7291, 7292, 7293, 7332, 7333, 7334, 7335, 7338, 7339, 7423

5489 (ANL/CP–77513) **Characterization of commercially pure aluminum powder for research reactor fuel plates.** Downs, V.D. (Babcock and Wilcox Co., Lynchburg, VA (United States)); Wiencek, T.C. Argonne National Lab., IL (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9209265–1: 1992 international meeting on reduced enrichment for research and test reactors, Roskilde (Germany), 27 Sep - 1 oct 1992). Order Number DE93003001. Source: OSTI; NTIS; INIS; GPO Dep.

Aluminum powder is used as the matrix material in the production of uranium aluminide, oxide, and silicide dispersion fuel plates for research and test reactors. variability in the characteristics of the aluminum powder, such as moisture content and particle-size distribution, influences blending and compacting of the aluminum/fuel powder. A detailed study was performed to characterize the physical properties of three aluminum powder lots. An angle-of-shear test was devised to characterize the cohesiveness of the aluminum powder. Flow-rate measurements, apparent density determination, subsieve analysis, surface area measurements, and scanning electron microscopy were also used in the study. It was found that because of the various types of commercially available powders, proper specification of powder variables will ensure the receipt of consistent raw materials. Improved control of the initial powder will reduce the variability of fuel-plate production and will improve overall plate reproducibility. It is recommended that a standard specification be written for the aluminum powder and silicide fuel.

5490 (ANL/EP/CP–77799) **The RERTR Program: A status report.** Travelli, A. Argonne National Lab., IL (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9209266–5: 1992 international meeting on reduced enrichment for research and test reactors, Roskilde (Denmark), 27 Sep - 1 oct 1992). Order Number DE93002926. Source: OSTI; NTIS; INIS; GPO Dep.

The progress of the Reduced Enrichment Research and Test Reactor (RERTR) Program is described. The major events, findings, and activities of 1991 are reviewed after a brief summary of the results which the RERTR Program had achieved by the end of 1991 in collaboration with its many international partners.

5491 (CDTN-NT–001/81) **Twenty years of Triga Mark I reactor use.** Stasiulevicius, R.; Maretti Junior, F. Centro de Desenvolvimento da Tecnologia Nuclear (CDTN), Belo Horizonte, MG (Brazil). 31 Aug 1981. [36] (In Portuguese). Order Number DE93609487. Source: OSTI; NTIS (US Sales Only); INIS.

This work is a report on the 20 years of activities of the Triga Mark I, research reactor located in Belo Horizonte, Brazil. It contains also a list of publications, details of operation and improvements introduced in the reactor as well as some perspectives for its future. (A.C.A.S.).

5492 (CONF-900143–39) **Sensor validation in power plants using adaptive backpropagation neural network.** Eryurek, E.; Upadhyaya, B.R. Tennessee Univ., Knoxville, TN (United States). Dept. of Nuclear Engineering. [1990]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG07-88ER12824. From Institute for Electronic and Electrical Engineers (IEEE) nuclear science symposium; San Francisco, CA (United States); 15-19 Jan 1990. Order Number DE93002959. Source: OSTI; NTIS; GPO Dep.

Signal validation and process monitoring problems in many cases require the prediction of one or more process variables in a system. The feasibility of using neural networks to characterize one variable as a function of other related variables is studied. The Backpropagation Network (BPN) is used to develop "models" of signals from both a commercial power plant and the EBR-II. Several innovations are made in the algorithm, the most significant of which is the progressive adjustment of the sigmoidal threshold function and weight updating terms, thus leading to the designation "Adaptive" Backpropagation Neural Network. The estimation of system variables is performed traditionally using either physical models or empirical models. The prediction of system variables is important in control systems for validating instrumentation outputs and for process monitoring. The model-based prediction assumes a fixed structure for characterizing steady-state or dynamic relationship among process variables. The applications to large and complex systems require more time in order to get an accurate model. Since our goal is to relate signals in a subsystem of a plant, such a relationship can be developed by using neural network "models" which provide results faster than model-based techniques. Both steady-state and transient behavior can be incorporated into the network during training.

5493 (CONF-921102–27) **Where have the neutrons gone: A history of the Tower Shielding Facility.** Muckenthaler, F.J. Oak Ridge National Lab., TN (United States). [1992]. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Joint American Nuclear Society (ANS)/European Nuclear Society (ENS) international meeting on fifty years of controlled nuclear chain reaction: past, present, and future; Chicago, IL (United States); 15-20 Nov 1992. Order Number DE93002429. Source: OSTI; NTIS; INIS; GPO Dep.

In the early 1950's, the concept of the unit shield for the nuclear powered aircraft reactor changed to one of the divided shield concept where the reactor and crew compartment shared the shielding load. Design calculations for the divided shield were being made based on data obtained in studies for the, unit shield. It was believed that these divided shield designs were subject to error, the magnitude of which could not be estimated. This belief led to the design of the Tower Shielding Facility where divided-shield-type measurements could be made without interference from ground or structural scattering. This paper discusses that facility, its reactors, and some chosen experiments from the list of many that were performed at that facility during the past 38 years.

5494 (DPW–53-7-4) **Process Section, Manufacturing Division monthly report, April 1953.** Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 15 May 1953. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–244). Order Number DE93002371. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report details activities of the Process Section of the Manufacturing Division during the month of April 1953.

5495 (DPW–53-614) **AEC research programs in support of Savannah River.** Squires, L. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 25 Mar 1953. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–245). Order Number DE93002372. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This memorandum discusses research programs at Atomic Energy Commission (AEC) National Laboratories which are considered necessary as direct support for the Savannah River Project.

5496 (DUN–1174-RD) **Reactor Operations daily report, July 1, 1966–June 30, 1967.** DeNeal, D.L. Douglas United Nuclear, Inc., Richland, WA (United States). 1 Jul 1966. 613p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE92040102. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document provides reactor operations daily reports for July 1, 1966 through June 30, 1967.

5497 (HW–3-2441) **Interim report No. 2 on Production Test No. 105-17-P, Laboratory evaluation of proposed lubricants.** Bankoff, S.G. Hanford Works, Richland, WA (United States). 15 May 1945. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003390. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The lubricant (Calel A-60) used to reduce pushing forces when discharging slugs from pile tubes forms a cloudy emulsion with water. During the initial period of operation at 100 B and D areas, spillage of lubricant during discharge produced so much cloudiness in the basin water that it interfered with sorting operations. An investigation was started to see if a lubricant could be found that would effectively lubricate tubes during discharge and which would form optically clear systems when mixed with water. This report presents the data on a number of lubricants which were suggested for test.

5498 (HW–7-4038) **"P" Department: 100-B Area shutdown progress report: Final report (Interim April 10–April 26, 1946).** Gross, C.N. Hanford Works, Richland, WA (United States). 28 Apr 1946. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003391. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Short communication HANFORD PRODUCTION REACTORS/ reactor shutdown; FUEL RODS; COOLING PONDS; REACTOR COOLING SYSTEMS; MAINTENANCE; PUMPS; REACTOR COMPONENTS; PROGRESS REPORT

5499 (HW–11867) **Description of facilities for Hanford irradiation of reactor materials.** Montgomery, E.B. Hanford Works, Richland, WA (United States). 15 Dec 1948. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002495. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document provides a brief description of the facilities available at Hanford for neutron irradiation of reactor materials and components.

5500 (HW–25470) **PT-105-408-P, Irradiation of insulators: Final report.** Lambert, J.B. Hanford Atomic Products Operation, Richland, WA (United States). 28 Aug 1952. 1p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003393. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Short communication. HANFORD PRODUCTION REACTORS; HEATERS/irradiation; FUEL RODS; HEATERS; IRRADIATION; TESTING; SEALS; PROGRESS REPORT

5501 (HW–27950) **Process Test MR-105-13, Determination of the value of zinc insert extensions in preventing sticking front nozzle inserts.** Hardin, A.K. Hanford Atomic Products Operation, Richland, WA (United States). 4 Jun 1953. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003435. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Short communication. HANFORD PRODUCTION REACTORS/shielding; SHIELDING; FUEL RODS; NOZZLES; CORROSION; ZINC; COATINGS

5502 (HW–28171) **Production Test No. 105-522-E, Examination of pile process tubes.** Falkoski, R.E. Hanford Atomic Products Operation, Richland, WA (United States). 25 May 1953. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003436. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The objective of the production test described in this report is to provide the authority and mechanism to remove process tubes from the piles for inspection. The test is intended to provide a more positive tube inspection program than was previously provided under production test number 105-9-P, "Corrosion of Slugs and Tubes", document number 7-3928.

5503 (HW–28531) **Provision for activated silica at 183-B.** Bupp, L.P. Hanford Works, Richland, WA (United States). 26 Jun 1953. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003437. Source: OSTI; NTIS (US Sales Only); GPO Dep.

In some discussions regarding water flow requirements for future pile power increases at the 100-B Area it was agreed that Pile Technology would explore the feasibility of slightly modifying the activated silica facility at 100-C to supply both areas. This letter summarizes the results of the survey and schedules tests which will allow recommendations to be confirmed.

5504 (HW–28784) **Process Test MR-105-15, Production increases by the use of venturi orifices.** Robb, J.E. Hanford Atomic Products Operation, Richland, WA (United States). 28 Jul 1953. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003439. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Process Test MR-105-14 presented the basis for the use of supplemental and venturi orifices in certain regions of a reactor operating in accordance with the scram before boiling limit, and provided for the reactor testing of the supplemental orifice. It is the purpose of the test, described in this report to demonstrate the feasibility of using venturi orifices on a reactor so that maximum production gains may be achieved under this new limit.

5505 (HW–29802) **Process Test MR-105-16 zinc shielding slugs.** Hardin, A.K. Hanford Atomic Products Operation, Richland, WA (United States). 4 Nov 1953. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003438. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Short communication. FUEL RODS/corrosion; HANFORD PRODUCTION REACTORS/fuel rods; CORROSION; TESTING; MODIFICATIONS; COST; SCHEDULES

5506 (HW–30150) **PT-105-519-E, Supplement A: Raising permissible outlet water temperatures of selected tubes at C Pile.** Goldsmith, S. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 7 Dec 1953. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003441. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report evaluates a method of eliminating localized corrosion attack of the slug can at the temperatures authorized by the original test.

5507 (HW–30959) **Development Test No. 105-518-SI—irradiation service request No. 132 low energy neutron flux spectrum in process tubes.** Marshall, R.K. Hanford Works, Richland, WA (United States). 5 Mar 1954. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003173. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Short communication. HANFORD PRODUCTION REACTORS/neutron flux; REACTOR KINETICS; IRRADIATION; SHIELDING; NEUTRON SPECTRA

5508 (HW–31519) **Process Test MR-105-19 evaluation of the slip joint C-Reactor rear pigtail replacement.** Schilling, R.D. Hanford Atomic Products Operation, Richland, WA (United States). 20 Apr 1954. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003396. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The C-Reactor is currently equipped with neoprene covered stainless steel bellows connectors between the rear face nozzles and crusaders. These pigtails are failing at an excessive rate and must be replaced at an early date. The replacement design, developed by Pile Technology Sub-Section, utilizes a relatively short length of stainless steel tubing and a slip joint sealed by "O"-rings. This report describes a test to evaluate the suitability of the slip joint pigtail as a replacement rear face connector.

5509 (HW–32372) **Process Test MR-105-23 cathodic protection of the 107-C retention basins.** Bloomstrand, R.R. Hanford Atomic Products Operation, Richland, WA (United States). 12 Jul 1954. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003399. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report provides details of a test to determine the feasibility of preventing corrosion of the 107- C retention basins by the installation of a small scale cathodic protection system.

5510 (HW–34095) **Water treatment modifications to present areas.** Pearl, W.L. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 26 Jan 1955. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003400. Source: OSTI; NTIS (US Sales Only); GPO Dep.

It is the purpose of this document to review and up-date the previously presented scope basis for the activated silica installations in light of the existence of the Phase I portion and the present expected water flow requirements of Project CG-558. It is the further purpose to outline the recommended scope bases for the sulfuric acid addition system for pH correction at all areas.

5511 (HW–34466) **Production Test 105-8-MR, Supplement A: Uranium charging during reactor operation.** Robb, J.E.; Schilling, R.D. Hanford Atomic Products Operation, Richland, WA (United States). 17 Jan 1955. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003401. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This memorandum describes a test which is to demonstrate the feasibility of routinely charging uranium slugs during reactor operation into tubes of the highest available powers and to provide functional testing of the equipment necessary to reduce such charging to a routine operation on all tubes in the reactor. This test will authorize the installation and routine operation of improved

equipment for charging and discharging uranium during reactor operation on five central process tubes at C Reactor.

5512 (HW–36762) **Interim report No. 1, RT 105-577-A: Irradiation of solid and cored hot pressed fuel elements.** Anderson, J.K. Hanford Works, Richland, WA (United States). 18 May 1955. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003403. Source: OSTI; NTIS (US Sales Only); GPO Dep.

In order to evaluate the performance of uranium slugs canned by the hot press method, several tubes of this metal were charged at C Pile and scheduled for irradiation until a specified number of ruptures had occurred. At the present time, all scheduled ruptures of hot-pressed slugs have been obtained. This report summarizes the irradiation experience under this test and the results obtained to the present time, and presents conclusions which are drawn from this experience.

5513 (HW–36898) **Estimate of life of manufacturing piles.** Milton, W.H. Jr. Hanford Works, Richland, WA (United States). 22 Oct 1946. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003405. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This memorandum provides an estimate of the life of manufacturing piles.

5514 (HW–36920) **Future power levels of Hanford Piles.** Greager, O.H. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 31 May 1955. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003404. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document was prepared in response to a request from the Atomic Energy Commission for a brief review of the principal ideas and technical developments which might effect power levels over the following six years. Also requested were approximate data on any pile modifications that might be involved, including rough estimates covering possible cost and completion dates. A brief discussion of plans for increasing the power levels of the Hanford Piles is provided.

5515 (HW–37658-Del.) **Hanford Atomic Products Operation monthly report for June 1955.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 28 Jul 1955. 367p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002503. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This is the monthly report for the Hanford Atomic Products Operation, June, 1955. Metallurgy, reactor fuels, chemistry, dosimetry, separation processes, reactor technology, financial activities, visits, biology operation, physics and instrumentation research, and employee relations are discussed.

5516 (HW–37694) **Development Test 105-558-E: Evaluation of high Na_2O neutralization in activated silica preparation.** Richman, R.B. Hanford Works, Richland, WA (United States). 30 Jun 1955. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003407. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This memorandum describes the development test is to establish the practicability of continuous activated silica production at greater than 92 per cent Na_2O neutralization (with subsequent short aging times).

5517 (HW–40694) **Future acid, silicate and silica requirements – 100 areas.** Bainard, W.D. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 30 Dec 1955. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003443. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document provides tables which give the computed acid, silicate, and silica requirements which will be necessary after completion of the water treatment plant expansion programs.

5518 (HW–43456) **Interim report, cocked-slug, flush-charging relations for C-Pile conditions.** McCarthy, P.B. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 29 Jun 1956. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003444. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Pile Engineering Sub-Section has been investigating the causes and effects of cocked slugs in process tubes for the past year because they are suspected to be the cause for some slug ruptures. In Project CG-642 - Continuous Charge-Discharge Equipment - C Reactor it is proposed that slugs be flush charged into the process tubes. This document reports the effect of flush charging slugs on their tendency to cock as discovered in laboratory tests.

5519 (HW–45102) **Production losses and reactor performance at the Hanford reactors.** Dow, T.D. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 29 Aug 1956. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003411. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Reactor performance currently is being measured primarily by the time operating efficiency. However, the time operating efficiency reveals only a partial picture of the overall reactor performance, since it indicates only the amount of time that the reactor is operating and indicates nothing concerning actual efficiency while operating. True efficiency is measured by the amount of production accomplished with respect to the production potential of the facility. To present a more accurate picture of reactor performance, two types of losses need to be examined in addition to losses resulting from normal outages. These are losses during non-equilibrium operating conditions and differences between plant potential level and the actually achieved equilibrium level. Losses of these types have been reported to the Process Evaluation Group by the reactor Operations Physicists. The purpose of this document is to report the results of an analysis of these data for the period of May through June, 1956, to determine the uses of this type of analysis, and to determine if such data should be collected and analyzed routinely.

5520 (HW–46757-Del.) **A study of expected reactor powers after project CG-558 as determined by slug rupture considerations.** Anderson, J.K. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 19 Nov 1956. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003412. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Studies were conducted to estimate at what powers the B, D, DR, F, and H Reactors will be limited by slug rupture frequencies after completion of project CG-558. Various approaches were used in the calculations. Methods of raising the reactors to the optimum power levels in a manner so as to protect against the possibility of an excessive number of slug ruptures were studied. This report discusses these studies and presents the conclusions drawn.

5521 (HW–51228) **Fuels Preparation Department monthly report, June 1957.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 19 Jul 1957. 51p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003446. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details the activities of the Fuels Preparation Department during the month of June 1957.

5522 (HW–52382) **Analysis of reactor water piping statement of problem and suggested solutions.** Bergman, K.L. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 6 Sep 1957. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003449. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Some of the various effects of reactor operation on process water piping have not been measured. This report recommends procedures to be used to obtain the information desired by various customers. Part of the data required is to insure safe rear-face piping conditions during pressurization of the rear-face piping of a reactor in the I.P.D. program to raise bulk effluent temperatures. Other data will be used to establish actual piping conditions as compared to design assumptions and to aid future designs and

modifications for longer life and safer operation at higher power levels.

5523 (HW–58142) **Fuels Preparation Department monthly report for October 1958.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 18 Nov 1958. 44p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003523. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report describes the operation of the fuels preparation department for the month of October, 1958. Manufacturing employee relations, process development, plant improvements and financial operations are described.

5524 (HW–59085) **Hanford Test Reactor operating manual.** Fitch, C.E. Jr. Hanford Works, Richland, WA (United States). 3 Feb 1959. 86p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002501. Source: OSTI; NTIS (US Sales Only); GPO Dep.

When the Test Reactor was first built, it was intended for testing graphite moderator only, but very soon it was recognized as a valuable tool for testing other reactor components. Some reactor components such as normal and special fuels are charged routinely and consequently, it is necessary to test these components to assure their nuclear quality prior to charging. This quality can be measured chemically, spectrographically, or with the Test Reactor. The purpose of this manual is to record all important routine testing procedures and set ups and to attempt to record special procedures used in typical special tests. The first section will be confined to routine testing which includes existing production components. The second section will include as many as possible of the typical special tests. The manual will be kept current with future procedure changes.

5525 (HW–62861) **Adequacy of the old reactor backup cooling systems.** Jones, S.S. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 1 Dec 1959. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002498. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document was submitted in support of the old reactor's plant expansion program. It includes the effects of the proposed large decreases in-reactor flow resistance upon the secondary and last-ditch flow supply. The purpose of this report is to serve as a basis for the design scope of a revised last ditch and water storage system adequate to handle the proposed increases in reactor flow and power level.

5526 (HW–63487) **Piping changes for increased production at B, D, DR, F, C, and H reactors.** Bauer, G.H.; Harrison, C.W.; Hill, V.R.; McLenegan, D.W.; Mondt, J.F. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 22 Jan 1960. 82p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003414. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This study proposes improvements in the process water piping adjacent to the front and rear faces of these reactors. This report covers the external piping of the reactors from the incoming valve pit to the inlets of the outgoing retention basins.

5527 (HW–67286-Del.) **Irradiation Processing Department monthly report, October 1960.** Westinghouse Hanford Co., Richland, WA (United States). 14 Nov 1960. 82p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003962. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the Irradiation Processing Department during the month of August, 1958. A general summary is included at the start of the report, after which the report is divided into the following sections: Research and Engineering Operations; Production and Reactor Operations; Facilities Engineering Operation; Employee Relations Operation; and Financial Operation.

5528 (HW–67681) **Irradiation Processing Department monthly report, November 1960.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 14 Dec 1960. 82p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003177. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the irradiation processing department during the month of November, 1960. A general summary is included at the start of the report, after which the report is divided into the following sections: Research and Engineering Operation; Production and Reactor Operations; Facilities Engineering Operation; Employee Relations Operation; Financial Operation; and NPR Project.

5529 (HW–68039) **Irradiation Processing Department monthly report, December 1960.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 16 Jan 1961. 87p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003456. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the Irradiation Processing Department during the month of December 1961.

5530 (HW–68343) **Irradiation Processing Department monthly report, January 1961.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Feb 1961. 89p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003528. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the irradiation processing department during the month of January, 1961. A general summary is included at the start of the report, after which the report is divided into the following sections: Research and Engineering Operations; Production and Reactor Operations; Facilities Engineering Operation; Employee Relations Operation; Financial Operation; and NPR Project.

5531 (HW–69080) **Irradiation Processing Department monthly report, March 1961.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 14 Apr 1961. 78p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003529. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the irradiation processing department during the month of March, 1961. A general summary is included at the start of the report, after which the report is divided into the following sections: Research and Engineering Operations; Production and Reactor Operations; Facilities Engineering Operation; Employee Relations Operation; Financial Operation; and NPR project.

5532 (HW–69491) **Irradiation Processing Department monthly report, April 1961.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 May 1961. 84p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003530. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the irradiation processing department during the month of April, 1961. A general summary is included at the start of the report, after which the report is divided into the following sections: Research and Engineering Operations; Production and Reactor Operations; Facilities Engineering Operations; Production and Reactor Operations; Facilities Engineering Operation; Employee Relations Operation; Financial Operation; and NPR project.

5533 (HW–70211) **Irradiation Processing Department monthly report, June 1961.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 17 Jul 1961. 85p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003531. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the irradiation processing department during the month of June, 1961. A general summary is included at the start of the report, after which the report is divided into the following sections: Research and Engineering Operations; Production and Reactor Operations; Facilities Engineering Operation; Employee Relations Operation; Financial Operation; and NPR Project.

5534 (HW–70625) **Irradiation Processing Department monthly report, July 1961.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 14 Aug 1961. 76p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003532. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the irradiation processing department during the month of July 1961. A general summary is included at the start of the report, after which the report is divided into the following sections: Research and Engineering Operations; Production and Reactor Operations; Facilities Engineering Operation; Employee Relations Operation; Financial Operation; and NPR Project.

5535 (HW–70952) **Irradiation Processing Department monthly report, August 1961.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Sep 1961. 74p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003501. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report details activities of the Irradiation Processing Department during the month of August 1961.

5536 (HW–71230) **Irradiation Processing Department monthly report, September 1961.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 16 Oct 1961. 76p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003302. Source: OSTI; NTIS; GPO Dep.

This document details activities of the irradiation processing department during the month of September, 1961. A general summary is included at the start of the report, after which the report is divided into the following sections: Research and Engineering Operations; Production and Reactor Operations; Facilities Engineering Operation; and NPR Project.

5537 (HW–71910) **Irradiation Processing Department monthly report, November 1961.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Dec 1961. 69p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003570. Source: OSTI; NTIS; GPO Dep.

This document details the activities of the Irradiation Processing Department during the month of November 1961.

5538 (HW–72567) **Irradiation Processing Department monthly report, January 1962.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Feb 1962. 75p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003502. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the Irradiation Processing Department during the month of January, 1962. A general summary is included at the start of the report, after which the report is divided into the following sections: Research and Engineering Operations; Production and Reactor Operations; Facilities Engineering Operation; and NPR Project.

5539 (HW–72813) **Irradiation Processing Department monthly report, February 1962.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Mar 1962. 75p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003457. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the irradiation processing department during the month of February, 1962. A general summary is included at the start of the report, after which the report is divided into the following sections: Research and Engineering Operations; Production and Reactor Operations: Facilities Engineering Operation; and NPR Project.

5540 (HW–74101) **Irradiation Processing Department monthly report, June 1962.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 13 Jul 1992. 66p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003573. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the Irradiation Processing Department during the month of June, 1962. A general summary is included at the start of the report, after which the report is divided into the following sections: Research and Engineering Operations; Production and Reactor Operations; Facilities Engineering Operation; and NPR Project.

5541 (HW–74309) **Irradiation Processing Department monthly report, July 1962.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 13 Aug 1962. 65p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003574. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the Irradiation Processing Department during the month of July, 1962. A general summary is included at the start of the report, after which the report is divided into the following sections: Research and Engineering Operations; Production and Reactor Operations; Facilities Engineering Operation; and NPR Project.

5542 (HW–74780) **Irradiation Processing Department monthly report, August 1962.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 14 Sep 1962. 71p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003575. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the Irradiation Processing Department during the month of August, 1962. A general summary is included at the start of the report, after which the report is divided into the following sections: Research and Engineering Operations; Production and Reactor Operations; Facilities Engineering Operation; and NPR Project.

5543 (HW–75089) **Irradiation Processing Department monthly report, September 1962.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 12 Oct 1962. 64p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003415. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the Irradiation Processing Department during the month of September 1962.

5544 (HW–75692) **Irradiation Processing Department monthly report, November 1962.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 14 Dec 1962. 48p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003504. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the Irradiation Processing Department during the month of November, 1962. A general summary is included at the start of the report, after which the report is divided into the following sections: Research and Engineering Operations; Production and Reactor Operations; Facilities Engineering Operation; Employee Relations Operation; and Financial Operation.

5545 (HW–75931) **Irradiation Processing Department monthly report, December 1962.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 14 Jan 1963. 65p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003175. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the Irradiation Processing Department during the month of December 1962.

5546 (HW–76398) **Irradiation Processing Department monthly report, January 1963.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Feb 1963. 66p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003176. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the irradiation processing department during the month of January, 1963. A general summary is included at the start of the report, after which the report is divided into the following sections: Research and Engineering Operations; Production and Reactor Operations; Facilities Engineering Operation; and Financial Operation.

5547 (HW–76769) **Irradiation Processing Department monthly report, February 1963.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 14 Mar 1963. 58p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003577. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the Irradiation Processing Department during the month of August, 1958. A general summary is included at the start of the report, after which the report is divided into the following sections: Research and Engineering Operations; Production and Reactor Operations; Facilities Engineering Operation; Employee Relations Operation; and Financial Operation.

5548 (HW–76814) **N-Reactor Department monthly report, February 1963.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 7 Mar 1963. 47p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003578. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report details activities of the N-Reactor Department during the month of February 1963.

5549 (HW–77045) **Irradiation Processing Department monthly report, March 1963.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 12 Apr 1963. 62p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003954. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the Irradiation Processing Department during the month of August, 1958. A general summary is included at the start of the report, after which the report is divided into the following sections: Research and Engineering Operations; Production and Reactor Operations; Facilities Engineering Operation; Employee Relations Operation; and Financial Operation.

5550 (HW–77499) **Irradiation Processing Department monthly report, April 1963.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 13 May 1963. 64p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003957. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the Irradiation Processing Department during the month of August, 1958. A general summary is included at the start of the report, after which the report is divided into the following sections: Research and Engineering Operations; Production and Reactor Operations; Facilities Engineering Operation; Employee Relations Operation; and Financial Operation.

5551 (HW–77749) **Irradiation Processing Department monthly report, May 1963.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 14 Jun 1963. 70p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003958. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the Irradiation Processing Department during the month of August, 1958. A general summary is included at the start of the report, after which the report is divided into the following sections: Research and Engineering Operations; Production and Reactor Operations; Facilities Engineering Operation; Employee Relations Operation; and Financial Operation.

5552 (HW–78029) **Irradiation Processing Department monthly report, June 1963.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Jul 1963. 36p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003959. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the irradiation processing department during the month of June, 1963. A general summary is included at the start of the report, after which the report is divided into the following sections: Research and Engineering Operations; Production and Reactor Operations; Facilities Engineering Operation; and Financial Operation.

5553 (HW–78034) **N-Reactor Department monthly report, June 1963.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 8 Jul 1963. 53p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003416. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report details activities of the N-Reactor Department during the month of June 1963.

5554 (HW–78451) **Irradiation Processing Department monthly report, July 1963.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 14 Aug 1963. 70p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003418. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the irradiation processing department during the month of July 1963. A general summary is included at the start of the report, after which the report is divided into the following sections: Research and Engineering Operations: Production and Reactor Operations; Facilities Engineering Operation; and Financial Operation.

5555 (HW–78490) **N-Reactor Department monthly report, July 1963.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 7 Aug 1963. 49p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003505. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report details activities of the N-Reactor Department during the month of July 1963.

5556 (HW–78780) **Irradiation Processing Department monthly report, August 1963.** Hanford Atomic Products Operation, Richland, WA (United States). 13 Sep 1963. 59p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003960. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the Irradiation Processing Department during the month of August, 1958. A general summary is included at the start of the report, after which the report is divided into the following sections: Research and Engineering Operations; Production and Reactor Operations; Facilities Engineering Operation; Employee Relations Operation; and Financial Operation.

5557 (HW–78805) **N-Reactor Department monthly report, August 1963.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 9 Sep 1963. 50p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003419. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report details activities of the N-Reactor Department during the month of August 1963.

5558 (HW–79070) **Irradiation Processing Department monthly report, September 1963.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 14 Oct 1963. 67p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003961. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the Irradiation Processing Department during the month of August, 1958. A general summary is included at the start of the report, after which the report is divided into the following sections: Research and Engineering Operations; Production and Reactor Operations; Facilities Engineering Operation; Employee Relations Operation; and Financial Operation.

5559 (HW–79107-Del.) **N-Reactor Department monthly report, September 1963.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 7 Oct 1963. 43p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003963. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the N-Reactor Department during the month of September 1963.

5560 (HW–79411) **Irradiation Processing Department monthly report, October 1963.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Nov 1963. 68p. Sponsored by USDOE, Washington, DC (United

States). DOE Contract AC06-76RL01830. Order Number DE93003417. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the irradiation processing department during the month of October, 1963. A general summary is included at the start of the report, after which the report is divided into the following sections: Research and Engineering Operations; Production and Reactor Operations; Facilities Engineering Operation; and Financial Operation.

5561 (HW–79448-Del.) **N-Reactor Department monthly report, October 1963.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 7 Nov 1963. 46p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003964. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the N-Reactor Department during the month of October 1963.

5562 (HW–79757) **Irradiation Processing Department monthly report, November 1963.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 13 Dec 1963. 64p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003420. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report details activities of the Irradiation Processing Department during the month of November 1963.

5563 (HW–79769) **N-Reactor Department monthly report, November 1963.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 9 Dec 1963. 41p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003580. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report details activities of the N-Reactor Department during the month of November 1963.

5564 (HW–80171) **Irradiation Processing Department monthly report, December 1963.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 14 Jan 1964. 61p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003965. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the irradiation processing department during the month of December, 1963. A general summary is included at the start of the report, after which the report is divided into the following sections: Research and Engineering Operations; Production and Reactor Operations; Facilities Engineering Operation; and Financial Operation.

5565 (HW–80559-1-Del.) **N-Reactor Department monthly report, January 1964.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 7 Feb 1964. 44p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003966. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the N-Reactor Department during the month of January 1964.

5566 (HW–80559-2) **N-Reactor Department monthly report, February 1964.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 9 Mar 1964. 48p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003429. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the N-Reactor Department during the month of February 1964.

5567 (HW–80559-3) **N-Reactor Department monthly report, March 1964.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 7 Apr 1964. 51p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003421. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report details activities of the N-Reactor Department during the month of March 1964.

5568 (HW–80559-4) **N-Reactor Department monthly report, April 1964.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 7 May 1964. 44p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003430. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report details activities of the N-Reactor Department during the month of April 1964.

5569 (HW–80559-5) **N-Reactor Department monthly report, May 1964.** Dickeman, R.L. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 8 Jun 1964. 54p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003422. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report details activities of the N-Reactor Department during the month of May 1964.

5570 (HW–80559-6-Del.) **N-Reactor Department monthly report, June 1964.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 7 Jul 1964. 57p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003967. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the N-Reactor Department during the month of June 1964.

5571 (HW–80559-7) **N-Reactor Department monthly report, July 1964.** Dickeman, R.L. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 10 Aug 1964. 57p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003423. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report details activities of the N-Reactor Department during the month of July 1964.

5572 (HW–80559-8-Del.) **N-Reactor Department monthly report, August 1964.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 8 Sep 1964. 64p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003968. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the N-Reactor Department during the month of August 1964.

5573 (HW–80559-9) **N-Reactor Department monthly report, September 1964.** Dickeman, R.L. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 8 Oct 1964. 47p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003424. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report details activities of the N-Reactor Department during the month of September 1964.

5574 (HW–80559-10-Del.) **N-Reactor Department monthly report, October 1964.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 10 Nov 1964. 46p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003969. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the N-Reactor Department during the month of October 1964.

5575 (HW–80559-11) **N-Reactor Department monthly report, November 1964.** Dickeman, R.L. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 10 Dec 1964. 39p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003425. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report details activities of the N-Reactor Department during the month of November 1964.

5576 (HW–80559-12) **N-Reactor Department monthly report, December 1964.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 11 Jan 1965. 52p. Sponsored by USDOE, Washington, DC (United States). DOE

Contract AC06-76RL01830. Order Number DE93003426. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report details activities of the N-Reactor Department during the month of December 1964.

5577 (HW–80581) **Irradiation Processing Department monthly report, January 1964.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 14 Feb 1964. 67p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003507. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the Irradiation Processing Department during the month of August, 1958. A general summary is included at the start of the report, after which the report is divided into the following sections: Research and Engineering Operations; Production and Reactor Operations; Facilities Engineering Operation; Employee Relations Operation; and Financial Operation.

5578 (HW–81000) **Irradiation Processing Department monthly report, February 1964.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 13 Mar 1964. 64p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003581. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report details activities of the Irradiation Processing Department during the month of February 1964.

5579 (HW–81001) **Irradiation Processing Department monthly report, March 1964.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 13 Apr 1964. 59p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003582. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report details activities of the Irradiation Processing Department during the month of March 1964.

5580 (HW–81002) **Irradiation Processing Department monthly report, April 1964.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 May 1964. 66p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003583. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report details activities of the Irradiation Processing Department during the month of April 1964.

5581 (HW–81003) **Irradiation Processing Department monthly report, May 1964.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Jun 1964. 64p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003508. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report details activities of the Irradiation Processing Department during the month of May 1964.

5582 (HW–81004) **Irradiation Processing Department monthly report, June 1964.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Jul 1964. 70p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003509. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the Irradiation Processing Department during the month of June, 1964. A general summary is included at the start of the report, after which the report is divided into the following sections: Research and Engineering Operations; Production and Reactor Operations; Facilities Engineering Operation; Employee Relations Operation; and Financial Operation.

5583 (HW–82940) **Irradiation Processing Department monthly report, July 1964.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 14 Jul 1964. 64p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003458. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the Irradiation Processing Department during the month of July 1964.

5584 (HW–82942) **Irradiation Processing Department monthly report, September 1964.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 9 Oct 1964. 73p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003427. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the irradiation processing department during the month of September, 1964. A general summary is included at the start of the report, after which the report is divided into the following sections: Research and Engineering Operations; Production and Reactor Operations; Facilities Engineering Operation; trips; and Financial Operation.

5585 (HW–82944) **Irradiation Processing Department monthly report, November 1964.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 14 Dec 1964. 71p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003459. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the irradiation processing department during the month of November, 1964. A general summary is included at the start of the report, after which the report is divided into the following sections: Research and Engineering Operations; Production and Reactor Operations; Facilities Engineering Operation; and Financial Operation.

5586 (HW–82945) **Irradiation Processing Department monthly report, December 1964.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Jan 1965. 64p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003428. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the irradiation processing department during the month of December, 1964. A general summary is included at the start of the report, after which the report is divided into the following sections: Research and Engineering Operations; Production and Reactor Operations; Facilities Engineering Operation; trips; and Financial Operation.

5587 (IAEA-TECDOC–643(v.4), pp. 47-48) **Babcock and Wilcox cladding and structural materials.** International Atomic Energy Agency, Vienna (Austria); Babcock and Wilcox Co., Lynchburg, VA (United States). Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* [594] Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

A listing of specifications for the aluminum alloys used by Babcock and Wilcox as cladding and structural materials for fabrication of research reactor fuel elements is provided. (author).

5588 (IAEA-TECDOC–643(v.4), pp. 457-476) **Specifications.** International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (United States); Michigan Univ., Ann Arbor, MI (United States). Ford Nuclear Reactor. Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* [594] Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

As part of the U.S. RERTR Program, a full-core demonstration with LEU fuel began in December 1981 in the Ford Nuclear Reactor (FNR) at the University of Michigan. The LEU standard and control fuel elements were manufactured by CERCA and by NUKEM using specifications prepared by ANL. The ANL specifications were derived from those prepared by EG and G-Idaho for HEU fuel elements manufactured for the FNR by Atomics International. Due to differences among fabricators in some of the normal manufacturing processes and materials, some of the specifications were negotiated by ANL and the University of Michigan with each manufacturer to arrive at mutually agreeable specifications. The specifications agreed to with NUKEM are presented here as an illustration only. A similar set of specifications was agreed to with CERCA. In this example, materials, material numbers, document numbers and drawing numbers specific to a single fabricator have been deleted. (author).

5589 (IAEA-TECDOC–643(v.4), pp. 477-504) **Inspection scheme.** International Atomic Energy Agency, Vienna (Austria); Argonne National Lab., IL (United States); Michigan Univ., Ann Arbor,

MI (United States). Ford Nuclear Reactor. Apr 1992. In *Research reactor core conversion guidebook. V. 4: Fuels (Appendices I-K).* [594] Order Number DE93607813. Source: OSTI; NTIS (US Sales Only); INIS.

As part of the U.S. RERTR Program, a full-core demonstration with LEU fuel began in December 1981 in the Ford Nuclear Reactor (FNR) at the University of Michigan. The LEU standard and control fuel elements were manufactured by CERCA and by NUKEM. The inspection scheme for standard fuel elements that was agreed to with NUKEM is presented here as an illustration only. A similar inspection scheme was agreed to with CERCA. In this example, all document numbers, drawing numbers, and form numbers have been deleted or replaced with a generic identification. (author).

5590 (IAEA-TECDOC–643(v.5), pp. 67-71) **Operational impacts of low enrichment uranium fuel conversion on the Ford Nuclear Reactor.** Burn, R.R. (Michigan Univ., Ann Arbor, MI (United States). Ford Nuclear Reactor). International Atomic Energy Agency, Vienna (Austria). Apr 1992. In *Research reactor core conversion guidebook. V. 5: Operations (Appendices L-N).* [153] Order Number DE93607574. Source: OSTI; NTIS (US Sales Only); INIS.

As part of the RERTR Program, a whole-core demonstration using LEU fuel began in the Ford Nuclear Reactor in December 1981. Numerous core performance measurements were made on a full HEU core, full LEU cores, and mixed cores of LEU and HEU fuel. The measurements included control rod worths, temperature and void coefficients, full core flux maps, and in-core and ex-core spectral measurements. Overall, no significant operational impacts resulted from conversion of the FNR from HEU to LEU fuel. (author). 1 fig.

5591 (INIS-BR–3083) **Neutronic studies for enrichment reduction of the IEA-R1 research reactor.** Maiorino, J.R.; Fanaro, L.C.B.; Mai, L.A.; Ferreira, P.S.B.; Garone, J.G.M. Instituto de Pesquisas Energeticas e Nucleares (IPEN), Sao Paulo, SP (Brazil). Div. de Fisica de Reatores. [1992][40] (In Portuguese). Order Number DE93609488. Source: OSTI; NTIS (US Sales Only); INIS.

This work describes the codes used for the IEA-R1 reactor calculations. The main purpose of these calculations is the use of neutronic studies to reduce its enrichment. (A.C.S.).

5592 (INIS-mf–13392) **Terminal project heat convection in thin cylinders.** Morales Corona, J. Universidad Autonoma Metropolitana, Mexico City (Mexico). Unidad Azcapotzalco. 1992[151] (In Spanish). Order Number DE93609489. Source: OSTI; NTIS (US Sales Only); INIS.

Heat convection in thin cylinders and analysis about natural convection for straight vertical plates, and straight vertical cylinders submersed in a fluid are presented some works carry out by different authors in the field of heat transfer. In the part of conduction, deduction of the equation of heat conduction in cylindrical coordinates by means of energy balance in a control volume is presented. Enthalpy and internal energy are used for the outlining of the equation and finally the equation in its vectorial form is obtained. In the convection part development to calculate the Nusselt number for a straight vertical plate by a forces analysis, an energy balance and mass conservation over a control volume is outlined. Several empiric correlations to calculate the Nusselt number and its relations with other dimensionless numbers are presented. In the experimental part the way in which a prototype rode is assembled is presented measurements of temperatures attained in steady state and in free convection for working fluids as air and water are showed in tables. Also graphs of Nusselt numbers obtained in the experimental way through some empiric correlations are showed (Author).

5593 (JAERI-M–92-097) **Experimental study on DNB heat flux of plate-type fuel in pressurized condition.** Komori, Yoshihiro (Japan Atomic Energy Research Inst., Oarai, Ibaraki (Japan). Oarai Research Establishment); Oshima, Kunio; Ishitsuka, Etsuo; Sakurai, Fumio; Sudo, Yukio; Saito, Minoru; Futamura, Yoshiaki; Kaminaga, Masanori. Japan Atomic Energy Research Inst., Tokyo (Japan). Jul 1992. 70p. (In Japanese). Order Number DE93754286. Source: OSTI; NTIS; INIS.

Experimental study was carried out in order to determine the DNB correlation for the safety analysis of the JMTR low enrichment fuel core. Since it is essential to examine applicability and safety margin of the correlation for the safety analysis, DNB heat fluxes were measured with the test section of rectangular flow channel simulating JMTR fuel element subchannel in the pressure range of $1 \approx 13$ kg/cm^2 abs and the velocity range of $0 \approx 4.4$ m/s. Reviewing existed DNB correlations based on the experimental data, Sudo correlations scheme was selected for the JMTR safety analysis with minor modification for the high flow rate region. Comparing the correlations scheme with experimental data, allowable limit of the minimum DNBR was determined to be 1.5. (author).

5594 (JAERI-M–92-098) **Neutronics design of JMTR-LEU core.** Nagaoka, Yoshiharu; Komukai, Bunsaku; Sakurai, Fumio; Koike, Sumio; Saito, Minoru; Futamura, Yoshiaki. Japan Atomic Energy Research Inst., Tokyo (Japan). Jul 1992. 87p. (In Japanese). Order Number DE93753273. Source: OSTI; NTIS; INIS.

The core conversion from MEU fuel to LEU of the JMTR, a 50 MW light water moderated and cooled tank type reactor using ETR-type fuel, is scheduled in 1993. As a part of the safety analyses for the JMTR LEU core, the neutronics characteristics analysis was carried out. In conversion to LEU fuel, the following things will be changed in JMTR operation: (1) extend the cycle length from 12 days in the present MEU core to 25 days, and (2) introduce cadmium wires with a diameter of 0.3 mm as burnable absorber in the sideplates to reduce the excess reactivity at the beginning of cycle. This report describes the analytical methods and results of the nuclear characteristics analysis of the JMTR LEU core. The results show that the LEU fuel core would provide neutronics characteristics similar to those of the MEU fuel core and the use of Cd burnable absorber is effective for the JMTR operation. (author).

5595 (JAERI-M–92-103) **Neutronic analysis on JRR-4 core by the use of low enriched uranium silicide fuels with several uranium densities.** Nakano, Yoshihiro (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment). Japan Atomic Energy Research Inst., Tokyo (Japan). Jul 1992. 73p. (In Japanese). Order Number DE93753323. Source: OSTI; NTIS; INIS.

The reduced enrichment program for JRR-4 has been going on in the Department of Research Reactor. Neutronic calculations using SRAC code system have been carried out in order to evaluate the neutronic characteristics of the core with low enriched uranium silicide fuel. In the calculations, changes of some neutronic characteristics were evaluated by changing the uranium density in the fuel meat. Analysis on the core with high enriched fuel was also performed to compare its characteristics with the silicide core. From these results obtained, it has been found that the uranium density of about 3.8 gU/cm^3 (for the inner plates) is adequate for JRR-4. Some calculations have been done to evaluate the effect of the change of neutron cross section libraries on the calculated results by using the continuous energy Monte Carlo code VIM. Results by VIM code were compared and showed very good agreements with ones by SRAC code. (author).

5596 (JAERI-M–92-113) **Experimental study of ^{238}U Doppler reactivity worth in FCA XVI-1 and XVI-2 cores.** Oigawa, Hiroyuki (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Okajima, Shigeaki; Mukaiyama, Takehiko; Satoh, Kunio. Japan Atomic Energy Research Inst., Tokyo (Japan). Aug 1992. 41p. (In Japanese). Order Number DE93754292. Source: OSTI; NTIS; INIS.

Doppler reactivity worths of natural uranium samples were measured in metallic fueled cores, FCA XVI-1 and XVI-2, using a sample heating technique. In a metallic fueled LMFBR, the neutron spectrum is generally harder than a similar size oxide fueled LMFBR owing to the luck of oxygen. The accuracy of Doppler effect calculation for a harder neutron spectrum was evaluated by comparing C/E values of Doppler reactivity worth in oxide fueled cores and in metallic fueled cores using FCA experiments. It was found that calculation using 70-group constant set JFS-3-J2 underestimates ^{238}U Doppler reactivity worth in metallic fueled cores. An inadequate treatment of resonance parameters of ^{238}U above 50 keV in JENDL-2 is one of the reasons for this underestimation. In JENDL-2 the resonance parameters of ^{238}U above 50 keV are not

included, and hence JFS-3-J2 which is processed from JENDL-2 does not have a self-shielding factor table above 40.9 keV of ^{238}U. When the contribution of this energy region for Doppler reactivity worth was corrected using ENDF/B-VI, which includes resonance parameters of ^{238}U up to 149 keV, the JFS-3-J2 based calculation gave 13% higher values for metallic sample experiments and 8% for oxide samples. Even after this correction, the calculation still gave smaller Doppler reactivity worths than the measurements, and the ratios of calculated value to experimental one vary widely from 0.6 to 1.0. (author).

5597 (PNL–7843) **Tritium permeation scoping experiments: LWR Tritium Target Development Program.** Marschman, S.C.; McKinley, S.G.; Clemmer, R.G.; Bell, R.D.; Britton, R.C.; Gray, W.J. Pacific Northwest Lab., Richland, WA (United States). Oct 1991. 40p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003982. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The objective of this investigation was to determine the tritium permeation characteristics of stainless steel cladding coated with aluminides by two different processes. The Tritium Permeation and Release Properties subtask of the Ex-Reactor Testing Task has the responsibility to test the tritium permeation properties of the barrier-coated cladding. A preliminary investigation of the tritium permeation properties of two prototypic light-water reactor (LWR), barrier-coated cladding specimens has been completed. The results are presented in this report. Two prototypic target rod segments were tested to determine their tritium permeation properties. Both tubes were exposed in 1-L autoclaves to temperature, pressure and water of similar chemistry expected for the WNP-1 reactor. Tritium was introduced to the interior of both tubes via a recirculating gas train for 10 days. It was assumed the tritium concentration measured in the autoclaves was the entire amount of tritium permeating through the tubes. The permeation rate for each tube was calculated based on this assumption. The measured tritium permeation flux for tube 1013 was $2.5 \cdot 10^{-14}$ Ci/cm^2 · s, while that measured for tube 877 was $3.4 \cdot 10^{-13}$Ci/cm^2 · s. Steady-state permeation was reached within 24 h. The calculated permeation flux for an uncoated stainless steel tube was $3.1 \cdot 10^{-9}$ Ci/cm^2 · s. The ratio of the bare stainless steel cladding permeation flux to the barrier-coated cladding permeation flux for tube 1013 was 79,200 and for tube 877 was 5,850. Microstructural examinations were conducted on both tubes to correlate the permeation properties with microstructure. The examinations revealed coatings of multiple phases.

5598 (WHC-SA–1586) **Thulium heat sources for space power application.** Alderman, C.J. Westinghouse Hanford Co., Richland, WA (United States). Oct 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930103–14: 10. symposium on space nuclear power and propulsion, Albuquerque, NM (United States), 10-14 Jan 1993). Order Number DE93002249. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Reliable electrical power supplies for use in transportation and remote systems will be an important part of space exploration activities on planet surfaces. A potential power source is available trough the use of thulium, a rare earth metal. Heat sources can be produced by neutron activation of naturally occurring thulium (Tm-169) targets in the base station nuclear power reactor. The resulting Tm-170 heat sources can be used in thermoelectric generators to power instrumentation and telecommunications systems located at remote sites. Combined with a dynamic Sterling or Brayton cycle conversion system, the heat source can power a lightweight electrical source for rovers or other surface transportation systems.

5599 (WHC-SP–0839) **Maintenance Implementation Plan for the Fast Flux Test Facility.** Crawford, C.N.; Duffield, M.F. Westinghouse Hanford Co., Richland, WA (United States). Jun 1992. 68p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93001751. Source: OSTI; NTIS; GPO Dep.

The maintenance program for the 400 Area, Fast Flux Test Facility (FFTF)Plant and plant support facilities includes the reactor plant, reactor support systems and equipment, Maintenance and Storage Facility, plant buildings, and building support systems. These are the areas of the facility that are covered by this plan. The personnel support facilities and buildings are maintained and supported by another department within Westinghouse Hanford, and are not included here. The FFTF maintenance program conducts the corrective and preventive maintenance necessary to ensure the operational reliability and safety of the reactor plant and support equipment. This comprehensive maintenance program also provides for maximizing the useful life of plant equipment and systems to realize the most efficient possible use of resources. The long-term future of the FFTF is uncertain; in the near term, the facility is being placed in standby. As the plant transitions from operating status to standby, the scope of the maintenance program will change from one of reactor operational reliability and life extension to preservation.

5600 (WSRC-MS–92-163) **Continuous tritium effluent water monitor at the Savannah River Site.** Hofstetter, K.J.; Wilson, H.T. Westinghouse Savannah River Co., Aiken, SC (United States). [1992]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-9209261–1: International conference on advances in liquid scintillation, Vienna (Austria), 14-18 Sep 1992). Order Number DE93002157. Source: OSTI; NTIS; GPO Dep.

A continuous monitor for tritium in water has been installed in the secondary cooling water effluent from the K-Reactor at the Savannah River Site (SRS). The monitor is designed to provide early detection of a small leak of the tritiated heavy water moderator and facilitate rapid isolation procedures. The tritium detector consists of an analysis cell containing 0.1–0.25 mm diameter beads of plastic scintillator interposed between two photomultiplier tubes and standard fast-slow coincidence electronics. A small portion of the effluent stream is first filtered through a series of cartridge filters (0.2 μm final filter) and then chemically treated by ion exchange resin and activated charcoal before reaching the cell. Flow through the detector is ≈3 mL/min. The tritium effluent water monitor (TEWM) will alarm if the tritium in the outfall exceeds 56 Bq/mL during a 10 minute counting interval. The installation and performance of the TEWM are discussed.

5601 (WSRC-MS–92-285) **CTOD-based acceptance criteria for heat exchanger head staybolts.** Lam, P.S.; Sindelar, R.L.; Barnes, D.M.; Awadalla, N.G. Westinghouse Savannah River Co., Aiken, SC (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930352–7: 2. international conference on nuclear engineering, San Francisco, CA (United States), 21-24 Mar 1993). Order Number DE93002403. Source: OSTI; NTIS; INIS; GPO Dep.

The primary coolant piping system of the Savannah River Site (SRS) reactors contains twelve heat exchangers to remove the waste heat from the nuclear materials production. A large break at the inlet or outlet heads of the heat exchangers would occur if the restraint members of the heads become inactive. The heat exchanger head is attached to the tubesheet by 84 staybolts. The structural integrity of the heads is demonstrated by showing the redundant capacity of the staybolts to restrain the head at design conditions and under seismic loadings. The beat exchanger head is analyzed with a three- dimensional finite element model. The restraint provided by the staybolts is evaluated for several postulated cases of inactive or missing staybolts, that is, bolts that have a flaw exceeding the ultrasonic testing (UT) threshold depth of 25% of the bolt diameter. A limit of 6 inactive staybolts is reached with a fracture criterion based on the maximum allowable local displacement at the active staybolts which corresponds to the crack tip opening displacement (CTOD) of 0.032 inches. An acceptance criteria methodology has been developed to disposition flaws reported in the staybolt inspections while ensuring adequate restraint capacity of the staybolts to maintain integrity of the heat exchanger heads against collapse. The methodology includes an approach for the baseline and periodic inspections of the staybolts. A total of up to 6 staybolts, reported as containing flaws with depths at or exceeding 25% would be acceptable in the heat exchanger.

5602 (WSRC-RP–92-756) **Analysis of K-Area core samples for K-Area formation stabilization work.** Langton, C.A. Westinghouse Savannah River Co., Aiken, SC (United States). 27 May 1992. 57p. Sponsored by USDOE, Washington, DC (United

States). DOE Contract AC09-89SR18035. Order Number DE93003381. Source: OSTI; NTIS; GPO Dep.

Foundation stabilization work in K-Area has been recently completed by Bechtel Inc. This effort involved pumping cement and cement-sand grout into unconsolidated sediments under K-Area. Subsequent to stabilization, core samples were collected to document the extent of grout flow in the area. Samples of this core were examined by SRTC personnel in support of the grouting program at the request of Bechtel personnel. This report summarizes the results of the SRTC study.

5603 (WSRC-TR–91-141) **Helium bubble distributions in reactor tank repair specimens: Part 1.** Tosten, M.H.; Kestin, P.A. Westinghouse Savannah River Co., Aiken, SC (United States). Mar 1992. 43p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93003374. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses the Reactor Tank Repair (RTR) program was initiated to develop an in-tank repair process capable of repairing stress corrosion cracks within the SRS reactor tank walls, in the event that such a repair is needed. Previous attempts to repair C-reactor tank with a gas tungsten arc (GTA) welding process were unsuccessful due to significant cracking that occurred in the heat-affected-zones adjacent to the repair welds. It was determined that this additional cracking was a result of helium embrittlement caused by the combined effects of helium (existing within the tank walls), the high heat input associated with the GTA process, and weld shrinkage stresses. Based on the results of earlier studies it was suggested that the effects of helium embrittlement could be minimized by using a low heat input GMA process. Metallographic analysis played an important role throughout the investigation of alternative welding methods for the repair of helium-containing materials.

5604 (WSRC-TR–92-076) **SHIELD verification and validation report.** Boman, C. Westinghouse Savannah River Co., Aiken, SC (United States). Feb 1992. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93003375. Source: OSTI; NTIS; INIS; GPO Dep.

This document outlines the verification and validation effort for the SHIELD, SHLDED, GEDIT, GENPRT, FIPROD, FPCALC, and PROCES modules of the SHIELD system code. Along with its predecessors, SHIELD has been in use at the Savannah River Site (SRS) for more than ten years. During this time the code has been extensively tested and a variety of validation documents have been issued. The primary function of this report is to specify the features and capabilities for which SHIELD is to be considered validated, and to reference the documents that establish the validation.

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Refer also to citation(s) 5440, 5441, 5462, 5473, 5479, 5480, 5486, 6203, 7466, 7467, 7468, 7469, 7470, 7475, 7476, 7481

5605 (ANL/RE/CP–77809) **Modeling the behavior of metallic fast reactor fuels during extended transients.** Kramer, J.M.; Liu, Y.Y.; Billone, M.C.; Tsai, H.C. Argonne National Lab., IL (United States). [1992]. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-921102–30: Joint American Nuclear Society (ANS)/European Nuclear Society (ENS) international meeting on fifty years of controlled nuclear chain reaction: past, present, and future, Chicago, IL (United States), 15-20 Nov 1992). Order Number DE93002918. Source: OSTI; NTIS; INIS; GPO Dep.

Passive safety features in the metal-fueled Integral Fast Reactor (IFR) make it possible to avoid core damage for extended time periods even when automatic scram systems fail to operate or heat removal systems are severely degraded. The time scale for these transients are intermediate between those that have traditionally been analyzed in fast reactor safety assessments and those of normal operation. Consequently, it has been necessary to validate models and computer codes (FPIN2 and LIFE-METAL) for application to this time regime. Results from out-of-reactor Whole Pin Furnace tests are being used for this purpose. Pretest predictions for tests FM-1 through FM-6 have been performed and calculations have been compared with the experimental measurements.

5606 (CONF-910535–6) **Vibration monitoring with artificial neural networks.** Alguindigue, I. (Tennessee Univ., Knoxville, TN (United States). Dept. of Nuclear Engineering); Uhrig, R.E. Tennessee Univ., Knoxville, TN (United States). Dept. of Nuclear Engineering. [1991]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG07-88ER12824 ;AC05-84OR21400. From 6. specialists meeting on reactor noise (SMORN); Gatlinburg, TN (United States); 19-24 May 1991. Order Number DE93003543. Source: OSTI; NTIS; INIS; GPO Dep.

Vibration monitoring of components in nuclear power plants has been used for a number of years. This technique involves the analysis of vibration data coming from vital components of the plant to detect features which reflect the operational state of machinery. The analysis leads to the identification of potential failures and their causes, and makes it possible to perform efficient preventive maintenance. Earlydetection is important because it can decrease the probability of catastrophic failures, reduce forced outgage, maximize utilization of available assets, increase the life of the plant, and reduce maintenance costs. This paper documents our work on the design of a vibration monitoring methodology based on neural network technology. This technology provides an attractive complement to traditional vibration analysis because of the potential of neural network to operate in real-time mode and to handle data which may be distorted or noisy. Our efforts have been concentrated on the analysis and classification of vibration signatures collected from operating machinery. Two neural networks algorithms were used in our project: the Recirculation algorithm for data compression and the Backpropagation algorithm to perform the actual classification of the patterns. Although this project is in the early stages of development it indicates that neural networks may provide a viable methodology for monitoring and diagnostics of vibrating components. Our results to date are very encouraging.

5607 (CONF-9109110–14) **Vibration monitoring of EDF rotating machinery using artificial neural networks.** Alguindigue, I.E. (Tennessee Univ., Knoxville, TN (United States). Dept. of Nuclear Engineering); Loskiewicz-Buczak, A.; Uhrig, R.E.; Hamon, L.; Lefevre, F. Tennessee Univ., Knoxville, TN (United States). Dept. of Nuclear Engineering. [1991]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG07-88ER12824. From International conference on frontiers in innovative computing for the nuclear industry; Jackson, WY (United States); 15-18 Sep 1991. Order Number DE93003557. Source: OSTI; NTIS; INIS; GPO Dep.

Vibration monitoring of components in nuclear power plants has been used for a number of years. This technique involves the analysis of vibration data coming from vital components of the plant to detect features which reflect the operational state of machinery. The analysis leads to the identification of potential failures and their causes, and makes it possible to perform efficient preventive maintenance. Earlydetection is important because it can decrease the probability of catastrophic failures, reduce forced outgage, maximize utilization of available assets, increase the life of the plant, and reduce maintenance costs. This paper documents our work on the design of a vibration monitoring methodology based on neural network technology. This technology provides an attractive complement to traditional vibration analysis because of the potential of neural networks to operate in real-time mode and to handle data which may be distorted or noisy. Our efforts have been concentrated on the analysis and classification of vibration signatures collected by Electricite de France (EDF). Two neural networks algorithms were used in our project: the Recirculation algorithm and the Backpropagation algorithm. Although this project is in the early stages of development it indicates that neural networks may provide a viable methodology for monitoring and diagnostics of vibrating components. Our results are very encouraging.

5608 (CONF-9109110–15) **Nuclear power plant status diagnostics using artificial neural networks.** Bartlett, E.B. (Iowa State Univ. of Science and Technology, Ames, IA (United States). Dept. of Mechanical Engineering); Uhrig, R.E. Tennessee Univ., Knoxville, TN (United States). Dept. of Nuclear Engineering. [1991]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE

Contract FG07-88ER12824. From International conference on frontiers in innovative computing for the nuclear industry; Jackson, WY (United States); 15-18 Sep 1991. Order Number DE93003560. Source: OSTI; NTIS; INIS; GPO Dep.

In this work, the nuclear power plant operating status recognition issue is investigated using artificial neural networks (ANNs). The objective is to train an ANN to classify nuclear power plant accident conditions and to assess the potential of future work in the area of plant diagnostics with ANNS. To this end, an ANN was trained to recognize normal operating conditions as well as potentially unsafe conditions based on nuclear power plant training simulator generated accident scenarios. These scenarios include; hot and cold leg loss of coolant, control rod ejection, loss of offsite power, main steam line break, main feedwater line break and steam generator tube leak accidents. Findings show that ANNs can be used to diagnose and classify nuclear power plant conditions with good results.

5609 (CONF-9109110–16) **Neural networks and their potential application to nuclear power plants.** Uhrig, R.E. (Tennessee Univ., Knoxville, TN (United States). Dept. of Nuclear Engineering). Tennessee Univ., Knoxville, TN (United States). Dept. of Nuclear Engineering. [1991]. 11p. Sponsored by USDOE, Washington, DC (United States); Electric Power Research Inst., Palo Alto, CA (United States). DOE Contract FG07-88ER12824 ;AC05-84OR21400. From International conference on frontiers in innovative computing for the nuclear industry; Jackson, WY (United States); 15-18 Sep 1991. Order Number DE93003559. Source: OSTI; NTIS; INIS; GPO Dep.

A network of artificial neurons, usually called an artificial neural network is a data processing system consisting of a number of highly interconnected processing elements in an architecture inspired by the structure of the cerebral cortex portion of the brain. Hence, neural networks are often capable of doing things which humans or animals do well but which conventional computers often do poorly. Neural networks exhibit characteristics and capabilities not provided by any other technology. Neural networks may be designed so as to classify an input pattern as one of several predefined types or to create, as needed, categories or classes of system states which can be interpreted by a human operator. Neural networks have the ability to recognize patterns, even when the information comprising these patterns is noisy, sparse, or incomplete. Thus, systems of artificial neural networks show great promise for use in environments in which robust, fault-tolerant pattern recognition is necessary in a real-time mode, and in which the incoming data may be distorted or noisy. The application of neural networks, a rapidly evolving technology used extensively in defense applications, alone or in conjunction with other advanced technologies, to some of the problems of operating nuclear power plants has the potential to enhance the safety, reliability and operability of nuclear power plants. The potential applications of neural networking include, but are not limited to diagnosing specific abnormal conditions, identification of nonlinear dynamics and transients, detection of the change of mode of operation, control of temperature and pressure during start-up, signal validation, plant-wide monitoring using autoassociative neural networks, monitoring of check valves, modeling of the plant thermodynamics, emulation of core reload calculations, analysis of temporal sequences in NRC's "licensee event reports," and monitoring of plant parameters.

5610 (CONF-9109447–2) **Hybrid expert system - neural network - Fuzzy Logic methodology for transient identification.** Ikonomopoulos, A. (Tennessee Univ., Knoxville, TN (United States). Dept. of Nuclear Engineering); Tsoukalas, L.H.; Uhrig, R.E. Tennessee Univ., Knoxville, TN (United States). Dept. of Nuclear Engineering. [1991]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG07-88ER12824. From 2. government neural network applications workshop; Huntsville, AL (United States); 10-12 Sep 1991. Order Number DE93003567. Source: OSTI; NTIS; GPO Dep.

A methodology is presented that demonstrates the potential of pretrained artificial neural networks (ANN's) as generators of membership functions for the purpose of transient identification in Nuclear Power Plants (NPP). In order to provide timely concise and task-specific information about the many aspects of the transient and to determine the state of the system based on the interpretation of potentially noisy data, a model-referenced approach is utilized, where pretrained ANNs provide the model. Membership functions – that condense information about a transient in a form convenient for a rule-based identification system – are produced through ANN'S. The results demonstrate the extremely good noise-tolerance of ANN's and suggest a new method for transient identification within the framework of Fuzzy Logic.

5611 (CONF-920432–14) **Use of neural networks to monitor power plant components.** Ikonomopoulos, A. (Tennessee Univ., Knoxville, TN (United States). Dept. of Nuclear Engineering); Tsoukalas, L.H.; Uhrig, R.E. Tennessee Univ., Knoxville, TN (United States). Dept. of Nuclear Engineering. [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG07-88ER12824 ;AC05-84OR21400. From 54. annual American power conference; Chicago, IL (United States); 13-15 Apr 1992. Order Number DE93003552. Source: OSTI; NTIS; INIS; GPO Dep.

A new methodology is presented for nondestructive evaluation (NDE) of check valve performance and degradation. Artificial neural network (ANN) technology is utilized for processing frequency domain signatures of check valves operating in a nuclear power plant (NPP). Acoustic signatures obtained from different locations on a check valve are transformed from the time domain to the frequency domain and then used as input to a pretrained neural network. The neural network has been trained with data sets corresponding to normal operation, therefore establishing a basis for check valve satisfactory performance. Results obtained from the proposed methodology demonstrate the ability of neural networks to perform accurate and quick evaluations of check valve performance.

5612 (CONF-930116–12) **Radiological consequence analyses under severe accident conditions for the Advanced Neutron Source Reactor at the Oak Ridge National Laboratory.** Taleyarkhan, R.P.; Kim, S.H.; Georgevich, V. Oak Ridge National Lab., TN (United States). Oct 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Probabilistic safety assessment international topical meeting (PSA 93); Clearwater Beach, FL (United States); 27-29 Jan 1993. Order Number DE93003097. Source: OSTI; NTIS; INIS; GPO Dep.

This paper discusses salient aspects of methodology, assumptions, modeling of various features related to radiation exposure, and health consequences from source terms resulting from two conservatively scoped severe accident scenarios. Radiological consequences for a site-suitability scenario based on 10 CFR 100 guidelines also are presented. Consequences arising from severe accidents involving steaming pools and core-concrete interaction (CCI) events combined with several different containment configurations are presented. Results are presented in the form of mean cumulative values for prompt and latent cancer fatality estimates and related cumulative, complementary distribution functions as a function of distance from the reactor site. It is shown that the reactor-site-suitability risk goals are met by a large margin and that overall risk is dominated by early containment failure combined with CCI events.

5613 (DPW–53-675) **Reactor-shutdown by earthquakes.** Worthington, H. Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Atomic Energy Div. 13 Apr 1953. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–260). Order Number DE93002726. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This memorhe importance of instrumentation to shut down reactors in case of an earthquake. A request is made to obtain design information on this instrumentation in order to fabricate a device to be utilized at the Savannah River Plant.

5614 (DPW–53-676) **Radiation from dual valves.** Heston, W.M. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 13 Apr 1953. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–259). Order Number DE93002725. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This memo is written in reply to a request for an estimate of the relative radiation intensity anticipated at the dual valves following detection of a slug failure.

5615 (GRS–92) **Safety assessment of unit 5 (WWER-440/W-213) of the Greifswald nuclear power station. Common German-Soviet report.** Gesellschaft fuer Reaktorsicherheit mbH (GRS), Koeln (Germany). Feb 1992. 196p. Translated from German: Sicherheitsbeurteilung des Kernkraftwerks Greifswald, Block 5 (WWER-440/W-213). Gemeinsamer deutsch-sowjetischer Bericht, GRS–88. Order Number DE93742737. Source: OSTI; NTIS (US Sales Only); INIS.

The report represents the common results of the program of German-Soviet cooperation in reactor safety and radiation protection. The technical plant and features of type WWER-440/W-213 nuclear power plants, basic legal licensing principles, reactor core and pressurized components, load resulting from accidents, systems engineering, spreading impacts, civil engineering aspects, and the evaluation of operating experience are described. (DG).

5616 (HW–36573) **Safety experience: Reactor and critical facilities.** Greager, O.H. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 6 May 1955. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003402. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document provides a discussion of reactor safety of the Hanford production reactor and critical facilities. A description of each facility is provided and details of significant safety incidents are provided.

5617 (HW–37304) **Operating history of Hanford Piles.** Talbott, J.W. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Jun 1955. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003406. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document has been written because of a request for information from the Advisory Committee on Reactor Safeguards. Hanford operating experience has been summarized in terms of operating hours, startups and scram analysis.

5618 (HW–56816-RD) **C-Pile pigtail failure.** Jones, S.S. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 18 Jul 1958. 123p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003454. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document provides conclusions made concerning inlet line (pigtail) rupture effects on the Hanford reactors.

5619 (IAEA-TECDOC–665, pp. 142-150) **Experience with nuclear power plant structural safety research in Finland.** Rintamaa, R. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Metallilaboratorio); Aaltonen, P.; Wallin, K.; Kauppinen, P.; Valo, M. International Atomic Energy Agency, Vienna (Austria). Sep 1992. (CONF-9105343–: IAEA-Technical Committee meeting on materials for advanced water-cooled reactors, Plzen (Czechoslovakia), 14-17 May 1991). In *Materials for advanced water cooled reactors: Proceedings of a technical committee meeting held in Plzen Czechoslovakia, 14-17 May 1991.* [163] Order Number DE93609447. Source: OSTI; NTIS (US Sales Only); INIS.

Reliable material property evaluation is a prerequisite to safety analysis of nuclear power plant components. The degradation of materials during the plant operation is one of the major concerns. In order to reduce the concern the effect of various factors like variation in material properties due to aging, mechanical loads, thermal loads, flaws, irradiation, corrosion, on the degree of material degradation must be understood. On the other hand knowing the major degradation mechanisms provides the highest potential to the improvement of materials technology. At the Technical Research Centre of Finland (VTT) the investigations related to material degradation mechanisms as well as to the safety assessment methods have been carried out over the last 20 years. Since the beginning of the year 1990 all research projects were organized into one research programme entitled "Nuclear Power Plant Structural Integrity". The purpose of this presentation is to overview shortly the research activities on the areas of experimental and computational fracture mechanics, material characterization and material degradation. The ongoing research activity and some material testing and analysis capabilities are briefly reviewed. (author). 18 refs, 7 figs, 1 tab.

5620 (INIS-mf–14094) **Recommendations of the RSK 1987-1991. Vol. 7.** BfS Schriften. Bundesamt fuer Strahlenschutz, Salzgitter (Germany). 1992 114p. (In German). Order Number DE93742867. Source: OSTI; NTIS (US Sales Only); INIS.

After publication of the recommendations in the Bundesanzeiger, the office of the RSK publishes them once more as a summary report by order of the Federal Minister for the Environment, Nature Conservation and Nuclear Safety. The report is divided generally into two parts: Part 1 contains the recommendations which are given by the RSK; part 2 contains the official notices concerning the RSK. There is also a subject index. (orig.).

5621 (INIS-XN–400) **Memorandum of Understanding between the Kingdom of Belgium and the Kingdom of the Netherlands on early notification of a nuclear accident and exchange of information on the operation of nuclear installations.** Belgium. 26 Mar 1991. [3] (In French, Dutch). Order Number DE93609756. Source: OSTI; NTIS (US Sales Only); INIS.

This Memorandum of Understanding was concluded on 20 December 1990 and provides for close collaboration between the two countries in the light of the 1986 Vienna Convention on Early Notification of a Nuclear Accidents, the 1984 Agreement between the two countries on mutual assistance in the event of catastrophes and accidents, and the 1987 European Community Council Decision on Community arrangements for the early exchange of information in the event of a radiological emergency. To this end, the Parties agree to respond promptly to requests for consultation or further information, to advise each other of any abnormal increase in radioactivity in their respective territories whatever its source, and to exchange information concerning national developments in the peaceful uses of nuclear energy and relevant laws. (NEA).

5622 (INIS-XN–410) **SFS 1991:1557-Act amending the Nuclear Liability Act (1968:45); of 5 December 1991.** Sweden. 16 Dec 1991. [1] (In Swedish). Order Number DE93609765. Source: OSTI; NTIS; INIS.

The Nuclear Liability Act has been amended to raise the maximum limit of the nuclear operator's liability from 800 million Skr to 1200 million Skr. The amending Act entered into force on 1 January 1992. (NEA).

5623 (JAERI-M–92-072) **Annual progress report on the NSRR experiments, (21): April 1989 through March 1990.** Japan Atomic Energy Research Inst., Tokyo (Japan). May 1992. 210p. (In Japanese). Order Number DE93753190. Source: OSTI; NTIS; INIS.

Fuel behavior studies under simulated reactivity-initiated accident (RIA) conditions have been performed in the Nuclear Safety Research Reactor (NSRR) since 1975. This report gives the results of experiments performed from April, 1989 through March, 1990 and discussions of them. A total of 41 tests were carried out during this period. The tests are distinguished into pre-irradiated fuel tests and fresh fuel tests; the former includes 2 JMTR pre-irradiated fuel tests, 2 PWR pre-irradiated fuel tests, and 2 BWR pre-irradiated fuel tests, and the latter includes 6 standard fuel tests (6 SP-CP scoping tests), 7 power and cooling condition parameter tests (4 flow shrouded fuel tests, 1 bundle simulation test, 1 fully water-filled vessel test, 1 high pressure/high temperature loop test), 12 special fuel tests (3 stainless steel clad fuel tests, 3 improved PWR fuel tests, 6 improved BWR fuel tests), 3 severe fuel damage tests (1 high temperature flooding test, 1 flooding behavior observation test, 1 debris coolability test), 3 fast breeder reactor fuel tests (2 moderator material characteristic measurement tests, 1 fuel behavior observation test), and 2 miscellaneous tests (2 preliminary tests for pre-irradiated fuel tests). (author).

5624 (JAERI-M–92-114) **Air oxidation behavior of fuel for the high temperature engineering test reactor (HTTR).** Kikuchi, Hironobu (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Hayashi, Kimio; Fukuda, Kousaku. Japan Atomic Energy Research Inst., Tokyo (Japan). Aug 1992. 26p. (In Japanese). Order Number DE93753349. Source: OSTI; NTIS; INIS.

The oxidation behavior of the HTTR fuel was studied with respect to the scenario of an air ingress accident which had been assessed in the HTTR safety analysis. The coated fuel particles were heated under a sufficient air flow in the temperature range of 900-1400degC for maximum duration of 600 h (at 1300degC). Failure fractions of the SiC coating layer after the heat treatments remained within the fraction at the fuel production. And the failure behavior of the SiC layer did not depend on such heating conditions as the temperature and the duration in the present experiment. It was confirmed by scanning electron microscopy (SEM), X-ray diffraction and laser Raman spectroscopy that a thin oxide film was formed on the SiC layer by the heat treatments. (author).

5625 (JAERI-M–92-150) **Study of two-phase flow under low velocity in PWR-LOCA.** Ohnuki, Akira (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment). Japan Atomic Energy Research Inst., Tokyo (Japan). Oct 1992. 146p. (In Japanese). Order Number DE93754367. Source: OSTI; NTIS; INIS.

In this research, when the hydrothermal behavior at the time of LOCA in PWRs is forecast with high accuracy by the optimal forecast code based on a two-fluid model, there are some problems in the accuracy of forecast of low velocity two-phase flow, therefore, the subjects related to it were studied. The subjects are the forecast using the multi-dimensional optimal forecast code of the heat transfer acceleration phenomena in high power output fuel assemblies originating in the radial power distribution in a core in the reflooding period at the time of LOCA, the evaluation of the applicability of the hydrothermal model in a core in reflooding period which was developed for 15 x 15 type fuel assemblies to 17 x 17 type fuel assemblies, the grasping of the mechanism of opposite flow limiting phenomena in hot leg, the elucidation of the scale effect of channels and the development of a model which is applicable up to actual reactor scale. The studies carried out on these subjects and the conclusions of respective studies are reported. (K.I.) 79 refs.

5626 (LA–12356) **Decommissioning the UHTREX Reactor Facility at Los Alamos, New Mexico.** Salazar, M.; Elder, J. Los Alamos National Lab., NM (United States). Aug 1992. 117p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93002708. Source: OSTI; NTIS; INIS; GPO Dep.

The Ultra-High Temperature Reactor Experiment (UHTREX) facility was constructed in the late 1960s to advance high-temperature and gas-cooled reactor technology. The 3-MW reactor was graphite moderated and helium cooled and used 93% enriched uranium as its fuel. The reactor was run for approximately one year and was shut down in February 1970. The decommissioning of the facility involved removing the reactor and its associated components. This document details planning for the decommissioning operations which included characterizing the facility, estimating the costs of decommissioning, preparing environmental documentation, establishing a system to track costs and work progress, and preplanning to correct health and safety concerns in the facility. Work to decommission the facility began in 1988 and was completed in September 1990 at a cost of $2.9 million. The facility was released to Department of Energy for other uses in its Los Alamos program.

5627 (LA-UR–92-3466) **Development and application of group importance measures.** Haskin, F.E. (New Mexico Univ., Albuquerque, NM (United States)); Huang, Min; Sasser, M.K.; Stack, D.W. Los Alamos National Lab., NM (United States). [1992]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930116–17: Probabilistic safety assessment international topical meeting (PSA 93), Clearwater Beach, FL (United States), 27-29 Jan 1993; N–6-92-R194). Order Number DE93003743. Source: OSTI; NTIS; INIS; GPO Dep.

As part of a complete Level I probabilistic safety analysis of the K Production Reactor, three traditional importance measures-risk reduction, partial derivative, and variance reduction-have been extended to permit analyses of the relative importance of groups of basic and initiating events. None of the group importance measures require Monte Carlo sampling for their quantification. The group importance measures are quantified for the overall fuel damage equation and for dominant accident sequences using the following event groups: initiating events, electrical failures, instrumentation failures, common-cause failures, human errors, and nonrecovery events. Additional analyses are presented using other event groups. Collectively, these applications indicate both the utility and the versatility of the group importance measures.

5628 (NUREG–0090-Vol.15-No.2) **Report to Congress on abnormal occurrences, April–June 1992: Volume 15, No. 2.** Nuclear Regulatory Commission, Washington, DC (United States). Office for Analysis and Evaluation of Operational Data. Sep 1992. 28p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

Section 208 of the Energy Reorganization Act of 1974 identifies an abnormal occurrence as an unscheduled incident or event that the nuclear Regulatory Commission determines to be significant from the standpoint of public health or safety and requires a quarterly report of such events to be made to Congress. This report covers the period from April 1 through June 30, 1992. Five abnormal occurrences are discussed in this report. One involved an extended loss of high-head safety injection capability at the Shearon Harris Nuclear Power Plant. The other four involved medical misadministrations (three therapeutic and one diagnostic) at NRC-licensed facilities. No abnormal occurrences were reported by NRC's Agreement States. The report also contains information updating a previously reported abnormal occurrence.

5629 (NUREG–0847-Suppl.10) **Safety Evaluation Report related to the operation of Watts Bar Nuclear Plant, Units 1 and 2 (Docket Nos. 50-390 and 50-391).** Tam, P.S. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Reactor Projects I/II. Oct 1992. 79p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This report supplements the Safety Evaluation Report (SER), NUREG-0847 (June 1982), Supplement No. 1 (September 1982), Supplement No. 2 (January 1984), Supplement No. 3 (January 1985), Supplement No. 4 (March 1985), Supplement No. 5 (November 1990), Supplement No. 6 (April 1991), Supplement No. 7 (September 1991), Supplement No. 8 (January 1992), and Supplement No. 9 (June 1992) issued by the Office of Nuclear Reactor Regulation of the US Nuclear Regulatory Commission with respect to the application filed by the Tennessee Valley Authority, as applicant and owner, for licenses to operate the Watts Bar Nuclear Plant, Units I and 2 (Docket Nos. 50-390 and 50-391). The facility is located in Rhea County, Tennessee, near the Watts Bar Dam on the Tennessee River. This supplement provides recent information regarding resolution of some of the outstanding and confirmatory items, and proposed license conditions identified in the SER.

5630 (NUREG/BR–0171-Vol.1) **Power reactor events and issues: Volume 1.** Nuclear Regulatory Commission, Washington, DC (United States). Office for Analysis and Evaluation of Operational Data. Oct 1992. 13p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This publication reviews selected operating events that have occurred at nuclear power plants and presents the results of NRC-sponsored analysis of pertinent operating issues. This study was initiated following several instances of water hammer involving the service water system at Arkansas Nuclear One. The task was to evaluate the need to reissue previous NRC guidance about water hammer or to suggest additional measures to prevent or mitigate their occurrence. Twelve from PWR and BWR type reactors were studied. This study concluded that the frequency of reported water hammer occurrences continues to drop and no new phenomena were identified as causes of water hammer. In addition, this study supports prior NRC conclusions regarding water hammer; however, some aspects that could impact safety and were identified in this study had not been previously emphasized.

5631 (NUREG/CP–0119-Vol.2, pp. 199-210) **SCDAP/RELAP5/MOD3 code development and assessment.** Allison, C.M. (Idaho National Engineering Lab., Idaho Falls (United States)); Heath, C.H.; Siefken, L.J.; Hohorst, J.K. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton,

NY (United States). Apr 1992. DOE Contract AC07-76ID01570. (CONF-911079–Vol.2: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 2, Severe accident research; Severe accident policy implementation; Accident management.* 504p. Source: OSTI; NTIS; INIS; GPO.

The SCDAP/RELAP5 computer code is designed to describe the overall reactor coolant system (RCS) thermal-hydraulic response, core damage progression, and fission product release and transport during severe accidents. The code is being developed at the Idaho National Engineering Laboratory (INEL) under the primary sponsorship of the Office of Nuclear Regulatory Research of the US Nuclear Regulatory Commission (NRC). The current version of the code, SCDAP/RELAP5/MOD3, was created in January, 1991 and reflects the merger of SCDAP/RELAP5/MOD2.5 damage progression and fission product transport models with RELAP5/MOD3 system thermal-hydraulics models. Systematic assessment of modeling uncertainties is currently underway. This paper describes the results of that assessment. Results presented include (a) a summary of important results from code-to-data comparisons, (b) estimates of modeling and experimental uncertainties, and (c) proposed model improvements to resolve the deficiencies identified in the assessment.

5632 (NUREG/CP–0119-Vol.2, pp. 367-381) **PWR instrument availability during severe accidents.** Arcieri, W.C. (Idaho National Engineering Lab., Idaho Falls (United States)); Hanson, D.J. Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (United States). Apr 1992. DOE Contract AC07-76ID01570. (CONF-911079–Vol.2: 19. Nuclear Regulatory Commission (NRC) water reactor safety information meeting, Bethesda, MD (United States), 28-30 Oct 1991). In *Proceedings of the US Nuclear Regulatory Commission nineteenth water reactor safety information meeting. Volume 2, Severe accident research; Severe accident policy implementation; Accident management.* 504p. Source: OSTI; NTIS; INIS; GPO.

The ability of plant personnel to successfully manage severe accidents strongly depends on the availability of timely and accurate plant status information. The United States Nuclear Regulatory Commission (USNRC) recognizes the importance of reliable plant information by making instrumentation one of the five elements of its accident management framework. This paper describes the results of research sponsored by the NRC to evaluate the availability of plant instrumentation during a range of possible severe accidents at a pressurized water reactor (PWR) with a large dry containment. The approach used to perform the instrument availability evaluation is based on the methodology developed during a previous NRC program which resulted in the publication of NUREG/CR-5513. NUREG/CR-5513 discusses the instruments needed by plant personnel involved in accident management to determine the status of the plant. The availability of these instruments during a severe accident initiated by a small break LOCA was evaluated in NUREG/CR-5513. This paper expands on the results presented in NUREG/CR-5513 by evaluating instrument availability based on the environmental conditions possible for a range of possible severe accidents that could occur at a pressurized water reactor (PWR) with a large dry containment. The expanded evaluation is presented in NUREG/CR-5691. These results indicate that instrumentation in some plant locations will not be available during certain phases of severe accidents.

5633 (NUREG/CP–0125) **Transactions of the Twentieth Water Reactor Safety Information Meeting.** Weiss, A.J. (comp.). Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research. Oct 1992. 228p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). (CONF-921007–: 20. water reactor safety information meeting, Bethesda, MD (United States), 21-23 Oct 1992). Source: OSTI; NTIS; INIS; GPO.

This report contains summaries of papers on reactor safety research to be presented at the 20th Water Reactor Safety Information Meeting at the Bethesda Marriott Hotel in Bethesda, Maryland, October 21–23, 1992. The summaries briefly describe the programs and results of nuclear safety research sponsored by the Office of Nuclear Regulatory Research, USNRC. Summaries of invited papers concerning nuclear safety issues from US government laboratories, the electric utilities, the Electric Power Research Institute (EPRI), the nuclear industry, and from foreign governments and industry are also included.

5634 (NUREG/CR–4832-Vol.4) **Analysis of the LaSalle Unit 2 Nuclear Power Plant: Risk Methods Integration and Evaluation Program (RMIEP): Volume 4, Initiating events and accident sequence delineation.** Payne, A.C. Jr. (Sandia National Labs., Albuquerque, NM (United States)); Eide, S.A.; LaChance, J.C.; Whitehead, D.W. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Safety Issue Resolution; Sandia National Labs., Albuquerque, NM (United States). Oct 1992. 115p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC04-76DP00789. (SAND–92-0537-Vol.4). Source: OSTI; NTIS; INIS; GPO.

This volume presents the results of the initiating event and accident sequence delineation analyses of the LaSalle Unit II nuclear power plant performed as part of the Level III PRA being performed by Sandia National Laboratories for the Nuclear Regulatory Commission. The initiating event identification included a thorough review of extant data and a detailed plant specific search for special initiators. For the LaSalle analysis, the following initiating events were defined: eight general transients, ten special initiators, four LOCAs inside containment, one LOCA outside containment, and two interfacing LOCAs. Three accident sequence event trees were constructed: LOCA, transient, and ATWS. These trees were general in nature so that a tree represented all initiators of a particular type (i.e., the LOCA tree was constructed for evaluating small, medium, and large LOCAs simultaneously). The effects of the specific initiators on the systems and the different success criteria were handled by including the initiating events directly in the system fault trees. The accident sequence event trees were extended to include the evaluation of containment vulnerable sequences. These internal event accident sequence event trees were also used for the evaluation of the seismic, fire, and flood analyses.

5635 (NUREG/CR–4832-Vol.10) **Analysis of the LaSalle Unit 2 Nuclear Power Plant, Risk Methods Integration and Evaluation Program (RMIEP): Volume 10, Internal flood analysis.** Ferrell, W.L. (Science Applications International Corp., Albuquerque, NM (United States)); Payne, A.C. Jr.; Daniel, S.L. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Safety Issue Resolution; Sandia National Labs., Albuquerque, NM (United States). Oct 1992. 273p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC04-76DP00789. (SAND–92-0537). Source: OSTI; NTIS; INIS; GPO.

This report is a description of the internal flood analysis performed on the LaSalle County Nuclear Generating Station, Unit 2. A more detailed integration with the internal events analysis than in prior flood risk assessments was accomplished. The same system fault trees used for the internal events analysis were also used for the flood analysis, which included modeling of components down to the contact pair level. Subsidiary equations were created to map the effects of pipe failures. All component locations were traced and mapped into the fault trees. The effects of floods were then mapped directly onto the internal plant model and their relative importance was evaluated. A detailed screening analysis was performed which showed that most plant areas had a negligible contribution to the flood-induced core damage frequency. This was influenced strongly by the fact that the LaSalle plant was designed with a high level of concern about the effects of external events such as fire and flood and significant separation was maintained between systems in the original design. Detailed analysis of the remaining flood scenarios identified only two that contributed significantly to risk. The flood analysis resulted in a total (mean) core damage frequency of 3.23E-6 per year.

5636 (NUREG/CR–5379-Vol.2) **Nuclear plant service water system aging degradation assessment: Volume 2, Phase 2.** Jarrell, D.B. (Pacific Northwest Lab., Richland, WA (United

States)); Larson, L.L.; Stratton, R.C.; Bohn, S.J.; Gore, M.L. Nuclear Regulatory Commission, Washington, DC (United States); Pacific Northwest Lab., Richland, WA (United States). Oct 1992. 59p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC06-76RL01830. (PNL–7916-Vol.2). Source: OSTI; NTIS; INIS; GPO.

This report discusses the second phase of the aging assessment of nuclear plant service water systems (SWSs) which was performed by the Pacific Northwest Laboratory (PNL) to support the US Nuclear Regulatory Commission's (NRC's) Nuclear Plant Aging Research (NPAR) program. The SWS was selected for study because of its essential role in the mitigation of and recovery from accident scenarios involving the potential for core-melt, and because it is subject to a variety of aging mechanisms. The objectives of the SWS task under the NPAR program are to identify and characterize the principal age-related degradation mechanisms relevant to this system, to assess the impact of aging degradation on operational readiness, and to provide a methodology for the management of aging on the service water aspect of nuclear plant safety. The primary degradation mechanism in the SWSs as stated in the Phase I assessment and confirmed by the analysis in Phase II, is corrosion compounded by biologic and inorganic accumulation. It then follows that the most effective means for mitigating degradation in these systems is to pursue appropriate programs to effectively control the water chemistry properties when possible and to use biocidal agents where necessary. A methodology for producing a complete root-cause analysis was developed as a result of needs identified in the Phase I assessment for a more formal procedure that would lend itself to a generic, standardized approach. It is recommended that this, or a similar methodology, be required as a part of the documentation for corrective maintenance performed on the safety-related portions of SWSs to provide an accurate focus for effective management of aging.

5637 (NUREG/CR–5790) **Risk evaluation for a B&W Pressurized Water Reactor, effects of fire protection system actuation on safety-related equipment: Evaluation of Generic Issue 57.** Lambright, J. (Sandia National Labs., Albuquerque, NM (United States)); Klamerus, E.; Daniel, S.; Lynch, J.; Ross, S. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Safety Issue Resolution; Sandia National Labs., Albuquerque, NM (United States). Sep 1992. 242p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC04-76DP00789. (SAND–91-1535). Source: OSTI; NTIS; INIS; GPO.

Nuclear power plants have experienced inadvertent actuations of fire protection systems (FPS) under conditions for which these systems were not intended to actuate. They have also experienced advertent actuations with the presence of a fire. These actuations have often damaged plant equipment. This document provides a review of the impact of past occurrences of both types of such events on nuclear power plant safety. Thirteen different scenarios leading to actuation of fire protection systems due to a variety of causes were identified. These scenarios ranged from inadvertent actuation caused by human error to hardware failure and includes seismic root causes and seismic/fire interaction. A quantification of these thirteen scenarios, where applicable, was performed on a Babcock and Wilcox Pressurized Water Reactor (lowered loop design). This report estimates the contribution of FPS actuations to core damage frequency and to risk.

5638 (NUREG/CR–5813-Vol.2) **Integrated Reliability and Risk Analysis System (IRRAS) Version 4.0: Tutorial: Volume 2.** VanHorn, R.L. (EG and G Idaho, Inc., Idaho Falls, ID (United States)); Russell, K.D.; Skinner, N.L. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Safety Issue Resolution; EG and G Idaho, Inc., Idaho Falls, ID (United States). Oct 1992. 136p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC07-76ID01570. (EGG–2664-Vol.2). Source: OSTI; NTIS; INIS.

This NUREG is the tutorial for the Integrated Reliability and Risk Analysis System (IRRAS) Version 4.0, a state-of-the-art, microcomputer-based probabilistic risk assessment (PRA) model development and analysis tool to address key nuclear plant safety issues. IRRAS is an integrated software tool that gives the user the ability to create and analyze fault trees and accident sequences using a microcomputer. In this tutorial, a series of lessons is provided that guides the user through basic steps common to most analyses performed with IRRAS. The tutorial is divided into two major sections: basic and additional features. The basic section contains lessons that lead the student through development of a very simple problem in IRRAS, highlighting the program's most basic features. The additional features section contains lessons that expand on basic features of IRRAS 4.0.

5639 (NUREG/CR–5816) **BWR stability analysis with the BNL Engineering Plant Analyzer.** Wulff, W. (Brookhaven National Lab., Upton, NY (United States)); Cheng, H.S.; Mallen, A.N.; Rohatgi, U.S. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Systems Research; Brookhaven National Lab., Upton, NY (United States). Oct 1992. 276p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC02-76CH00016. (BNL-NUREG–52312). Source: OSTI; NTIS; INIS; GPO.

March 9, 1989 instability at the LaSalle-2 Power Plant and more than ninety related BWR transients have been simulated on the BNL Engineering Plant Analyzer (EPA). Power peaks were found to be potentially seventeen times greater than the rated power, flow reversal occurs momentarily during large power oscillations, the fuel centerline temperature oscillates between 1,030 and 2,090 K, while the cladding temperature oscillates between 560 and 570 K. The Suppression Pool reaches its specified temperature limit either never or in as little as 4.3 minutes, depending on operator actions and transient scenario. Thermohydraulic oscillations occur at low core coolant flow (both Recirculation Pumps tripped), with sharp axial or redial fission power peaking and with partial loss of feedwater preheating while the feedwater is flow kept high to maintain coolant inventory in the vessel. Effects from BOP system were shown to influence reactor stability strongly through closed-loop resonance feedback. High feedwater flow and low temperature destabilize the reactor. Low feedwater flow restabilizes the reactor, because of steam condensation and feedwater preheating in the downcomer, which reduces effectively the destabilizing core inlet subcooling. The EPA has been found to be capable of analyzing BWR stability " shown to be effective for scoping calculations and for supporting accident management.

5640 (NUREG/CR–5823) **Analysis of standby and demand stress failures modes: Methodology and applications to EDGs and MOVs.** Lofgren, E.V. (Science Applications International Corp., McLean, VA (United States)); Thaggard, M. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Safety Issue Resolution; Science Applications International Corp., McLean, VA (United States). Oct 1992. 117p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). (SAIC–87-029). Source: OSTI; NTIS; INIS; GPO.

This report describes work to develop and demonstrates methods for partitioning standby component failure modes into causes that fail the component while it is in standby, and when it changes state, during testing or from other demands. Failure of the component from standby stresses is modeled using a model that explicitly contains the length of the test interval. Failure of the component from demand stresses such as vibration, wind, etc., is modeled using the probability of failure on demand model. Misuse of these models in PRAS, could lead to PRAs that, give misleading results, or that are more useful for decision purposes. A method was developed and demonstrated to partition standby/demand stresses. The method was used on the work maintenance records from two Nuclear Power Plants (NPPs) to estimate reliability parameters for Motor Operated Valves And Emergency Diesel Generators (EDGs).

5641 (NUREG/CR–5827) **Auxiliary feedwater system risk-based inspection guide for the Catawba Nuclear Power Plant.** Moffitt, N.E. (Pacific Northwest Lab., Richland, WA (United States)); Gore, B.F.; Vo, T.V. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Radiation Protection and Emergency Preparedness; Pacific Northwest Lab., Richland, WA (United States). Sep 1992. 29p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC06-76RL01830. (PNL–7726). Source: OSTI; NTIS; INIS; GPO.

In a study sponsored by the US Nuclear Regulatory Commission (NRC), Pacific Northwest Laboratory has developed and applied a methodology for deriving plant specific risk-based inspection guidance for the auxiliary feedwater (AFW) system at pressurized water reactors that have not undergone probabilistic risk assessment (PRA). This methodology uses existing PRA results and plant operating experience information. Existing PRA-based inspection guidance information recently developed for the NRC for various plants was used to identify generic component failure modes. This information was then combined with plant-specific and industry-wide component information and failure data to identify failure modes and failure mechanisms for the AFW system at the selected plants. Catawba was selected as one of a series of plants for study. The product of this effort is a prioritized listing of AFW failures which have occurred at the plant and at other PWRs. This listing is intended for use by NRC inspectors in the preparation of inspection plans addressing AFW risk-important components at the Catawba plant.

5642 (NUREG/CR–5831) **Auxiliary feedwater system risk-based inspection guide for the Comanche Peak Nuclear Power Plant.** Lloyd, R.C. (Pacific Northwest Lab., Richland, WA (United States)); Moffitt, N.E.; Gore, B.F.; Vo, T.V. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Radiation Protection and Emergency Preparedness; Pacific Northwest Lab., Richland, WA (United States). Oct 1992. 32p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC06-76RL01830. (PNL–7783). Source: OSTI; NTIS; INIS; GPO.

In a study sponsored by the US Nuclear Regulatory Commission (NRC), Pacific Northwest Laboratory has developed and applied a methodology for deriving plant-specific risk-based inspection guidance for the auxiliary feedwater (AFW) system at pressurized water reactors that have not undergone probabilistic risk assessment (PRA). This methodology uses existing PRA results and plant operating experience information. Existing PRA-based inspection guidance information recently developed for the NRC for various plants was used to identify generic component failure modes. This information was then combined with plant-specific and industry-wide component information and failure data to identify failure modes and failure mechanisms for the AFW system at the selected plants. Comanche Peak was selected as one of a series of plants for study. The product of this effort is a prioritized listing of AFW failures which have occurred at the plant and at other PWRS. This listing is intended for use by the NRC inspectors in preparation of inspection plans addressing AFW risk-important components at the Comanche Peak plant.

5643 (NUREG/CR–5832) **Auxiliary feedwater system risk-based inspection guide for the D.C. Cook Nuclear Power Plant.** Lloyd, R.C. (Pacific Northwest Lab., Richland, WA (United States)); Moffitt, N.E.; Gore, B.F.; Vo, T.V.; Isom, J.A. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Radiation Protection and Emergency Preparedness; Pacific Northwest Lab., Richland, WA (United States). Oct 1992. 32p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC06-76RL01830. (PNL–7782). Source: OSTI; NTIS; INIS; GPO.

In a study sponsored by the US Nuclear Regulatory Commission (NRC), Pacific Northwest Laboratory has developed and applied a methodology for deriving plant-specific risk-based inspection guidance for the auxiliary feedwater (AFW) system at pressurized water reactors that have not undergone probabilistic risk assessment (PRA). This methodology uses existing PRA results and plant operating experience information. Existing PRA-based inspection guidance information recently developed for the NRC for various plants was used to identify generic component failure modes. This information was then combined with plant-specific and industry-wide component information and failure data to identify failure modes and failure mechanisms for the AFW system at the selected plants. D.C. Cook was selected as one of a series of plants for study. The product of this effort is a prioritized listing of AFW failures which have occurred at the plant and at other PWRs. This listing is intended for use by NRC inspectors in the preparation of inspection plans addressing AFW risk-important components at the D.C. Cook plant.

5644 (NUREG/CR–5839) **Auxiliary feedwater system risk-based inspection guide for the Prairie Island Units 1 and 2 nuclear power plants.** Moffitt, N.E. (Pacific Northwest Lab., Richland, WA (United States)); Gore, B.F.; Vo, T.V. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Radiation Protection and Emergency Preparedness; Pacific Northwest Lab., Richland, WA (United States). Oct 1992. 31p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC06-76RL01830. (PNL–7605). Source: OSTI; NTIS; INIS; GPO.

In a study sponsored by the US Nuclear Regulatory Commission (NRC), Pacific Northwest Laboratory has developed and applied a methodology for deriving plant-specific risk-based guidance for the a feedwater (AFW) system at pressurized water reactors that have not undergone probabilistic risk assessment (PRA). This methodology uses existing PRA results and plant operating experience information. Existing PRA-based inspection guidance information recently developed for the NRC for various plants was used to identify generic component failure modes.This information was then combined with plant-specific and industry-wide component information and failure data to identify failure modes and failure mechanisms for the AFW system at the selected plants. Prairie Island was selected as the seventh plant for study. The product of this effort is a prioritized listing of AFW failures which have occurred at the plant and at other PWRs. This listing is intended for use by NRC inspectors in the preparation of inspection plans addressing AFW risk-important components at the Prairie Island plant.

5645 (NUREG/CR–5869) **Identification and assessment of BWR in-vessel severe accident mitigation strategies.** Hodge, S.A. (Oak Ridge National Lab., TN (United States)); Cleveland, J.C.; Kress, T.S.; Petek, M. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Systems Research; Oak Ridge National Lab., TN (United States). Oct 1992. 221p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. (ORNL/TM–12080). Source: OSTI; NTIS; INIS; GPO.

This report provides the results of work carried out in support of the US Nuclear Regulatory Commission Accident Management Research Program to develop a technical basis for evaluating the effectiveness and feasibility of current and proposed strategies for boiling water reactor (BWR) severe accident management. First, the findings of an assessment of the current status of accident management strategies for the mitigation of in-vessel events for BWR severe accident sequences are described. This includes a review of the BWR Owners' Group Emergency Procedure Guidelines (EPGSs) to determine the extent to which they currently address the characteristic events of an unmitigated severe accident and to provide the basis for recommendations for enhancement of accident management procedures. Second, where considered necessary, new candidate accident management strategies are proposed for mitigation of the late-phase (after core damage has occurred) events. Finally, recommendations are made for consideration of additional strategies where warranted, and two of the four candidate strategies identified by this effort are assessed in detail: (1) preparation of a boron solution for reactor vessel refill should control blade damage occur during a period of temporary core dry-out and (2) containment flooding to maintain the core debris within the reactor vessel if the injection systems cannot be restored.

5646 (NUREG/CR–5887) **Posttest analysis of MIST Test 3109AA using TRAC-PF1/MOD1.** Steiner, J.L. (Los Alamos National Lab., NM (United States)); Siebe, D.A.; Boyack, B.E. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Systems Research; Los Alamos National Lab., NM (United States). Sep 1992. 71p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract W-7405-ENG-36. (LA-UR–89-2158). Source: OSTI; NTIS; INIS; GPO.

This document discusses a posttest calculation and analysis of Multi-loop Integral System Test (MIST) 3109AA as the nominal test for the MIST program. It is a test of a small-break loss-of-coolant accident (SBLOCA) with a scaled 10-cm^2 break in the B1 cold leg.

The test exhibited the major post-SBLOCA phenomena, as expected, including depressurization to saturation, intermittent and interrupted loop flow, boiler-condenser mode cooling, refill, and postrefill cooldown. Full high-pressure injection and auxiliary feedwater were available, reactor coolant pumps were not available, and reactor-vessel vent valves and guard heaters were automatically controlled. Constant level control in the steam-generator secondaries was used after steam-generator secondary refill and symmetric steam-generator pressure control was used. We performed the calculation using TRAC-PF1/MODl. Agreement between test data and the calculation was generally reasonable. All major trends and phenomena were correctly predicted. It is believed that the correct conclusions about trends and phenomena will be reached if the code is used in similar applications.

5647 (NUREG/CR–5888) **Posttest analysis of MIST Test 320201 using TRAC-PF1/MOD1.** Siebe, D.A. (Los Alamos National Lab., NM (United States)); Steiner, J.L.; Boyack, B.E. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Systems Research; Los Alamos National Lab., NM (United States). Sep 1992. 67p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract W-7405-ENG-36. (LA-UR–89-673). Source: OSTI; NTIS; INIS; GPO.

A posttest calculation and analysis of Multi-Loop Integral System Test 320201, a small-break loss-of-coolant accident (SBLOCA) test with a scaled 50-cm^2 cold-leg pump discharge leak, has been completed and is reported herein. It was one in a series of tests, with leak size varied parametrically. Scaled leak sizes included 5, 10, (the nominal, Test 3109AA), and 50 cm_2. The test exhibited the major post-SBLOCA phenomena, as expected, including depressurization to saturation, interruption of loop flow, boiler-condenser mode cooling, refill, and postrefill cooldown. Full high-pressure injection and auxiliary feedwater were available, reactor coolant pumps were not available, and reactor-vessel vent valves and guard heaters were automatically controlled. Constant level control in the steam-generator (SG) secondaries was used after SG-secondary refill; and symmetric SG pressure control was also used. The sequence of events seen in this test was similar to the sequence of events for much of the nominal test except that events occurred in a shorter time frame as the system inventory was reduced and the system depressurized at a faster rate. The calculation was performed using TRAC-PFL/MOD 1. Agreement between test data and the calculation was generally reasonable. All major trends and phenomena were correctly predicted. We believe that the correct conclusions about trends and phenomena will be reached if the code is used in similar applications.

5648 (NUREG/CR–5889) **Posttest analysis of MIST Test 330302 using TRAC-PF1/MOD1.** Boyack, B.E. (Los Alamos National Lab., NM (United States)). Nuclear Regulatory Commission, Washington, DC (United States). Div. of Systems Research; Los Alamos National Lab., NM (United States). Sep 1992. 86p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract W-7405-ENG-36. (LA-UR–88-1937). Source: OSTI; NTIS; INIS; GPO.

This report discusses a posttest analysis of Multi-Loop Integral System Test (MIST) 330302 which has been performed using TRAC-PF1/MOD1. This test was one of group performed in the MIST facility to investigate high-pressure injection (HPI)-power-operated relief valve (PORV) cooling, also known as feed-and-bleed cooling. In Test 330302, HPI cooling was delayed 20 min after opening and locking the PORV open to induce extensive system voiding. We have concluded that the TRAC-calculated results are in reasonable overall agreement with the data for Test 330302. All major trends and phenomena were correctly predicted. Differences observed between the measured and calculated results have been traced and related, in part, to deficiencies in our knowledge of the facility configuration and operation. We have identified two models forwhich additional review is appropriate. However, in general, the TRAC closure models and correlations appear to be adequate for the prediction of the phenomena expected to occur during feed-and-bleed transientsin the MIST facility. We believe that the correct conclusions about trends and phenomena will be reached if the code is used in similar applications. Conclusions reached regarding use of the code to calculate similar phenomena in full-size plants (scaling implications) and regulatory implications of this work are also presented.

5649 (NUREG/CR–5900-Vol.1-No.1) **Pressure vessel safety research for advanced reactors: Semiannual progress report for December 1991–March 1992: Volume 1, No. 1.** Huddleston, R.L. (Oak Ridge National Lab., TN (United States)). Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Oak Ridge National Lab., TN (United States). Nov 1992. 24p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. (ORNL/TM–12136/V1-No.1). Source: OSTI; NTIS; INIS; GPO.

The NRC sponsored "Pressure Vessel Safety Research for Advanced Reactor" project was initiated at Oak Ridge National Laboratory in December 1992. The objective of the project is to identify and assist NRC in resolving any outstanding safety issues in the materials, fabrication, design, or environmental effects areas for the reactor pressure vessel for the advanced reactors such that these issues do not negatively impact the design certification process. The major output from this project during the first year will be white papers summarizing the unresolved issues with recommended plans for their resolution. The project will address two advanced evolutionary, two advanced passive, and four advanced reactor systems. During this first report period progress included: development of a detailed technical approach to be followed in identifying and resolving the issues; identification of documents containing information needed for the assessments and requesting these through official channels; identification of relevant design code and regulatory documents and acquiring those which are not locally available; development of a listing of information needed from the reactor manufacturers in preparation for visiting the manufacturers to bold discussions with their technical personnel; development of a preliminary outline for the white papers, and initiation of document reviews.

5650 (NUREG/CR–5924) **High Pressure Coolant Injection (HPCI) system risk-based inspection guide: Pilgrim Nuclear Power Station.** Shier, W. (Brookhaven National Lab., Upton, NY (United States)); Gunther, W. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Radiation Protection and Emergency Preparedness; Brookhaven National Lab., Upton, NY (United States). Oct 1992. 50p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC02-76CH00016. (BNL-NUREG–52339). Source: OSTI; NTIS; INIS; GPO.

A review of the operating experience for the High Pressure Coolant Injection (HPCI) system at the Pilgrim Nuclear Power Station is described in this report. The information for this review was obtained from Pilgrim Licensee Event Reports (LERs) that were generated between 1980 and 1989. These LERs have been categorized into 23 failure modes that have been prioritized based on probabilistic risk assessment considerations. In addition, the results of the Pilgrim operating experience review have been compared with the results of of a similar, industry wide operating experience review. this comparison provides an indication of areas in the Pilgrim HPCI system that should be given increased attention in the prioritization of inspection resources.

5651 (NUREG/CR–5925-Vol.1) **Risk-based technical specifications: Development and application of an approach to the generation of a plant specific real-time risk model: Main report, Volume 1.** Puglia, B. (Science Applications International Corp., Reston, VA (United States)); Gallagher, D.; Amico, P.; Atefi, B. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Operational Events Assessment; Science Applications International Corp., Reston, VA (United States). Oct 1992. 78p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). (SAIC–92/6668-R1-Vol.1). Source: OSTI; NTIS; INIS; GPO.

This report describes a process developed to convert an existing PRA into model amenable to real time risk-based technical specification calculations. In earlier studies culminating in (NUREG/CR-5742), several risk-based approaches to technical specification were evaluated. A real-time approach using a plant specific PRA capable of modeling plant configurations as they change was identified as the most comprehensive approach to control plant risk. A

master fault tree logic model representative of-all of the core damage sequences was developed. Portions of the system fault trees were modularized and supercomponents comprised of component failures with similar effects were developed to reduce the size of the model and quantification times. Modifications to the master fault tree logic were made to properly model the effect of maintenance and recovery actions. Fault trees representing several actuation systems not modeled in detail in the existing PRA were added to the master fault tree logic. This process was applied to the Surry NUREG-1150 Level 1 PRA. The accuracy of the master logic model was confirmed. The model was then used to evaluate the core damage frequency associated with several plant configurations using the IRRAS code. For all cases analyzed the computational time was less than three minutes.

5652 (PNL-SA-21322) **Radionuclide characterization at US commercial light-water reactors for decommissioning assessment: Distributions, inventories, and waste disposal considerations.** Abel, K.H.; Robertson, D.E.; Thomas, C.W. Pacific Northwest Lab., Richland, WA (United States). Sep 1992. 18p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9209243–1: Advisory group meeting on nuclear data requirements for fission reactor decommissioning, Vienna (Austria), 7-11 Sep 1992). Order Number DE93001555. Source: OSTI; NTIS; INIS; GPO Dep.

A continuing research program, conducted by Pacific Northwest Laboratory for the US Nuclear Regulatory Commission, characterizing radionuclide concentrations associated with US light-water reactors has been conducted for more than a decade. The research initially focused upon sampling and analytical measurements for the purpose of establishing radionuclide distributions and inventories for decommissioning assessment, since very little empirical data existed. The initial phase of the research program examined radionuclide concentrations and distributions external to the reactor vessel at seven US light water reactors. Later stages of the research program have examined the radionuclide distributions in the highly radioactive reactor internals and fuel assembly. Most recently, the research program is determining radionuclide concentrations in these highly radioactive components and comparing empirical results with those derived from the several nonempirical methodologies employed to estimate radionuclide inventories for disposal classification. The results of the research program to date are summarized, and their implications and significance for the decommissioning process are noted.

5653 (SAND–92-1373C) **MELCOR assessment: LOFT integral experiment LP-FP-2.** Kmetyk, L.N.; Thompson, S.L. Sandia National Labs., Albuquerque, NM (United States). [1992]. 10p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930352–5: 2. international conference on nuclear engineering, San Francisco, CA (United States), 21-24 Mar 1993). Order Number DE93002485. Source: OSTI; NTIS; INIS; GPO Dep.

The MELCOR code has been used to model experiment LP-FP-2, an important source of integral data for qualifying severe accident code predictive capabilities. A large number of sensitivity studies were done, investigating the effect of various thermal/hydraulic, core-damage and source-term code models and parameters, together with time-step and machine-dependency numerics studies. The results of this assessment analysis clearly demonstrate MELCOR's ability to fulfill a large portion of its primary intended use, the fully integrated calculation of severe accidents from full-power steady-state initiation through primary-system thermal/hydraulic response and core damage to fission product release, transport and deposition.

5654 (SAND–92-1723C) **Survey of MELCOR assessment.** Kmetyk, L.N.; Thompson, S.L. Sandia National Labs., Albuquerque, NM (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930352–4: 2. international conference on nuclear engineering, San Francisco, CA (United States), 21-24 Mar 1993). Order Number DE93002297. Source: OSTI; NTIS; INIS; GPO Dep.

MELCOR is a fully integrated, engineering-level computer code that models the progression of severe accidents in light water reactor nuclear power plants and is being developed at Sandia National Laboratories for the USNRC and the USDOE. The entire spectrum of severe accident phenomena, including reactor coolant system and containment thermal/hydraulic response, core heatup, degradation and relocation, and fission product release and transport, is treated in MELCOR in a unified framework for both BWRs and PWRS. MELCOR was the first of the severe accident analysis codes to undergo a formal review process, and one of the major conclusions of the MELCOR Peer Review was the need for a more comprehensive and more systematic program of MELCOR assessment. Since then, a number of assessment analyses have been completed and more assessment calculations axe under way. This paper presents a review of MELCOR verification, validation and assessment to date.

5655 (SAND–92-1750C) **MELCOR assessment at SNL.** Kmetyk, L.N. Sandia National Labs., Albuquerque, NM (United States). [1992]. 25p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9210204–1: Water reactor safety information meeting, Washington, DC (United States), Oct 1992). Order Number DE93002473. Source: OSTI; NTIS; INIS; GPO Dep.

MELCOR is a fully integrated, engineering-level computer code that models the progression of severe accidents in light water reactor (LWR) nuclear power plants, being developed at Sandia National Laboratories for the US Nuclear Regulatory Commission (USNRC). The entire spectrum of severe accident phenomena, including reactor coolant system and containment thermal/hydraulic response, core heatup, degradation and relocation, and fission product release and transport, is treated in MELCOR in a unified framework for both boiling water reactors (BWRS) and pressurized water reactors (PWRs). The MELCOR computer code has been developed to the point that it is now being successfully applied in severe accident analyses, particularly in probabilistic risk assessment (PRA) studies. MELCOR was the first of the severe accident analysis codes to undergo a formal peer review process. One of the major conclusions of the recent MELCOR Peer Review was the need for a more comprehensive and more systematic program of MELCOR assessment. A systematic program of code assessment provides a number of benefits, including: 1. guidance to the code developers in identification of areas where code improvements are needed (such as coding implementation errors in models, inappropriate or deficient models, missing models, excessive numerical sensitivities), 2. documented evidence to external observers, users, reviewers and project management that the code is modelling required phenomena correctly, and 3. increased general public acceptance that the code adequately treats issues related to public safety concerns.

5656 (SAND–92-2242C) **Topaz II preliminary safety assessment.** Marshall, A.C. (Sandia National Labs., Albuquerque, NM (United States)); Standley, V.; Voss, S.S.; Haskin, E. Sandia National Labs., Albuquerque, NM (United States). [1992]. 7p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930103–16: 10. symposium on space nuclear power and propulsion, Albuquerque, NM (United States), 10-14 Jan 1993). Order Number DE93002457. Source: OSTI; NTIS; INIS; GPO Dep.

The Strategic Defense Initiative Organization (SDIO) decided to investigate the possibility of launching a Russian Topaz 11 space nuclear power system. A preliminary safety assessment was conducted to determine whether or not a space mission could be conducted safely and within budget constraints. As part of this assessment, a safety policy and safety functional requirements were developed to guide both the safely assessment and future Topaz II activities. A review of the Russian flight safety program was conducted and documented. Our preliminary safety assessment included a top level event tree, neutronic analysis of normal and accident configurations, an evaluation of temperature coefficients of reactivity, a reentry and disposal analysis, and analysis of postulated launch abort impact accidents, and an analysis of postulated propellant fire and explosion accidents. Based on the assessment,

it appears that it will be possible to safely launch the Topaz II system in the US with some possible system modifications. The principal system modifications will probably include design changes to preclude water flooded criticality and to assure intact reentry.

5657 (SAND–92-2264C) **Plans for containment bellows testing under extreme loads.** Spletzer, B.L.; Lambert, L.D.; Parks, M.B. Sandia National Labs., Albuquerque, NM (United States). [1992]. 14p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-921007–3: 20. water reactor safety information meeting, Bethesda, MD (United States), 21-23 Oct 1992). Order Number DE93002477. Source: OSTI; NTIS; INIS; GPO Dep.

Piping penetrations in nuclear power plant steel containments are surrounded by flexible metal bellows. The purpose of the bellows is to maintain the containment pressure boundary integrity while permitting relative movement between the piping and the containment wall. In a severe accident, bellows may be subjected to high temperatures, pressure, and combinations of lateral and axial deflections. Sandia National Laboratories (SNL), under sponsorship of the Nuclear Regulatory Commission (NRC), is performing a series of tests to investigate the performance of containment bellows under severe accident conditions.

5658 (SAND–92-2342C) **Nuclear thermal rocket entry heating and thermal response preliminary analysis.** Potter, D.L.; Connell, L.W.; Wong, C. Channy; Kniskern, M.W. Sandia National Labs., Albuquerque, NM (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930108–2: 31. American Institute of Astronautics and Aeronautics (AIAA) aerospace sciences meeting, Reno, NV (United States), 11-14 Jan 1993; AIAA–93-0378). Order Number DE93002460. Source: OSTI; NTIS; INIS; GPO Dep.

This preliminary study analyzes the atmospheric entry of a solid core nuclear thermal rocket (NTR) engine under three accidental entry scenarios. Depending on the scenario, results of the analysis showed that, without external thermal protection, an aluminum pressure vessel will fail at altitudes ranging 25 to 73 km. subsequent release the core materials occurs. The graphitic based core materials will undergo partial ablation, with the percent mass loss depending on the geometry of the fuel elements. A carbon-phenolic thermal protection system was sized to prevent pressure vessel aerothermal failure. It was found to increase the mass of the NTR by approximately 15 percent.

5659 (WHC-SP–0300) **Safety analysis irradiated N Reactor fuel.** Westinghouse Hanford Co., Richland, WA (United States). Jul 1988. 118p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (UNI-M–143). Order Number DE93001476. Source: OSTI; NTIS; INIS; GPO Dep.

This Safety Analysis Report (SAR) covers the handling, segregation, and storage of N Reactor fuel in the modified 105-KE and KW fuel storage basins. It also covers special safety modifications to railroad facilities and special operating procedures for railroad equipment adjacent to the basins.

5660 (WSRC-MS–92-026) **Analysis of production reactor response during a postulated Loss-of-River Water event using CONTAIN/SR.** O'Kula, K.R. (Westinghouse Savannah River Co., Aiken, SC (United States)); Wooten, L.A.; Jenkins, T.B. Westinghouse Savannah River Co., Aiken, SC (United States). 1 Jun 1992. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930352–6: 2. international conference on nuclear engineering, San Francisco, CA (United States), 21-24 Mar 1993). Order Number DE93002689. Source: OSTI; NTIS; GPO Dep.

This report discusses the CONTAIN/SR computer code, developed at the Savannah River Technology Center and Sandia National Laboratories for Probabilistic Safety Assessment (PSA) applications, which is used to analyze K Reactor plant conditions following a design basis earthquake to assist post-accident recovery planning. The postulated event, a Loss-of-River Water (LORW) accident, requires analysis of the K Reactor confinement system assuming seismic event-caused loss of forced air flow through Radiologically Controlled (RCAs) and other building areas, including adjoining personnel and auxiliary equipment zones. The CONTAIN/SR code calculations predict the expected environment in the K Reactor building with a seismically-qualified flow path for natural circulation, under design basis conditions specifying a 50 gal/min leak of tritiated heavy water. Despite loss of active fan flow, preferential air flow patterns are calculated to flow from "clean" areas towards the RCAs. Ventilation characteristics of the building reduce tritiated water vapor concentrations to habitable levels, assuming plastic suits and clean breathing air supplies are available. Unprotected dose rates to recovery workers in the heat exchanger zone of the building will range from 120 mrem/hour to 780 mrem/hour, depending on evaporation conditions near spilled heavy-water pools. It is concluded habitability issues for recovery are not driven by temperature concerns in reactor building zones. However, the results indicate radiological suits with cool air supplies will assure adequate conditions for operators and recovery teams, and mitigate tritium uptake hazards from splashing or other direct contact mechanisms.

5661 (WSRC-MS–92-152) **PSA uncertainties introduced by use of the PARTITION computer code for source term clustering.** Brandyberry, M.D.; Kearnaghan, D.P.; East, J.M. Westinghouse Savannah River Co., Aiken, SC (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930116–9: Probabilistic safety assessment international topical meeting, Clearwater Beach, FL (United States), 27-29 Jan 1993). Order Number DE93002811. Source: OSTI; NTIS; INIS; GPO Dep.

The PARTITION computer code has been used in the SRS K-reactor Full Scope PSA to cluster the many source terms resulting from the accident progression analysis into a manageable number of averaged source terms. Very little guidance is given in Reference 1 for use of the various options that are available in the program. A series of sensitivity studies has been performed that shows, with a few exceptions, that the mean values and risk measures calculated for the PSA are insensitive to the procedures used to partition the source terms. It was discovered, however, that if too few partitions are used, certain risk measures may be affected due to the source term averaging process.

5662 (WSRC-MS–92-265) **Consequences of expansion joint bellows rupture.** Daugherty, W.L.; Miller, R.F.; Cramer, D.S. Westinghouse Savannah River Co., Aiken, SC (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930352–3: 2. international conference on nuclear engineering, San Francisco, CA (United States), 21-24 Mar 1993). Order Number DE93002173. Source: OSTI; NTIS; INIS; GPO Dep.

Expansion joints are used in piping systems to accommodate pipe deflections during service and to facilitate fitup. Typically, the expansion joint bellows is the thinnest part of the pressure boundary, bellows rupture frequencies are typically several orders of magnitude higher than pipe rupture frequencies. This paper reviews an effort to estimate the flow rates associated with bellows rupture. The Level I PRA (probabilistic risk assessment) for the Savannah River Site production reactors made the bounding assumption that bellows rupture would produce the maximum possible leakage - that of a double-ended guillotine break (DEGB). This assumption resulted in predictions of flooding of the reactor building with a high conditional probability that a Loss of Pumping Accident and core melting would follow. This paper describes analyses that were performed to develop a realistic break area and leak rate resulting from bellows rupture and therefore reduce the impact that bellows rupture can have on the estimated total core melt frequency. In the event of a 360 degree circumferential break of the bellows the resulting two sections will separate to the point where the force from the internal pressure acting to push the bellows open is just balanced by the spring force of the bellows itself. For the bellows addressed in this analysis, the equilibrium separation distance is 0.7 inches with normal pump lineup. The opening area is influenced by any initial compression or extension due to installation alignment, and by any operational displacements such as thermal expansion of the adjoining pipe. The influence of such factors is considered and the impact on the flooding rate and, hence, core melt frequency is reviewed.

5663 (WSRC-MS–92-288) **Rapid quenching of molten lithium-aluminum jets in water.** Greene, G.A. (Brookhaven National Lab., Upton, NY (United States)); Cho, D.H.; Hyder, M.L.; Allison, D.K.; Ellison, P.G. Westinghouse Savannah River Co., Aiken, SC (United States). [1992]. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-930352–2: 2. international conference on nuclear engineering, San Francisco, CA (United States), 21-24 Mar 1993). Order Number DE93001896. Source: OSTI; NTIS; GPO Dep.

Control rods for the K production reactor at Savannah River, are grouped in assemblies of seven rods, called "septifoils". A problem area is that overheated cooling rods for these control rods might partially melt, with the resulting molten metal draining into the water at the bottom. Experiments were conducted in which up to 1 kg molten alloy was contacted with water at a time. Conditions were varied in an attempt to include those factors that might trigger a vapor explosion. Results indicate that a steam explosion that would damage the septifoil is unlikely.

24 POWER TRANSMISSION AND DISTRIBUTION

2401 Power Systems

Refer also to citation(s) 5748, 5750

5664 (CONF-930353–1) **Geomagnetic storm environments and effects on electrical systems.** Tesche, F.M. (Tesche (F.M.), Dallas, TX (United States)); Barnes, P.R. Oak Ridge National Lab., TN (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 10. international Zurich symposium and technical exhibition on electromagnetic compatibility; Zurich (Switzerland); 9-11 Mar 1993. Order Number DE92041257. Source: OSTI; NTIS; GPO Dep.

This paper briefly reviews the behavior of the earth's magnetic field during a geomagnetic storm. Temporal variations of the B-field on the earths surface can induce an electric field in the earth, and this E-field will induce currents to flow in long, grounded conductors. Previous experience with geomagnetic storms indicates that such geomagnetically-induced currents can cause damage to power system components, and at times, can cause power blackouts. This paper presents some recently measured geomagnetic field variations, and illustrates how the induced electric field can be calculated, assuming a simple model of the imperfectly conducting earth. This calculation may be performed either in the time or in the frequency domain. Approximations to the time dependence of the geomagnetic field permit an analytical evaluation of the corresponding E-field in the earth, and this results in a simple expression for the transient Enfield. A knowledge of this Enfield is important in understanding the effects of geomagnetic storms on the power system, and in devising protection methods.

5665 (ETDE-IT–92-99) **New developments in application of ENEL transmission system voltage and reactive power automatic control.** Arcidiacono, V.; Corsi, S.; Menditto, V.; Natale, A.; Raffaelli, C. Ente Nazionale per l'Energia Elettrica, Milan (Italy); Ente Nazionale per l'Energia Elettrica, Rome (Italy). 1990. 7p. Order Number DE93748399. Source: OSTI; NTIS (US Sales Only).

This paper briefly reviews the main design and operating characteristics of the new voltage and reactive power automatic control system set up by ENEL (Italian Electricity Board) for its extrahigh ac power transmission system. A discussion is also made of the first results obtained by ENEL in its application of a secondary voltage regulation system now operating in the Tuscany and Sicily regions. The report concludes with a look at the innovative features of the micro-processor based power plant reactive power and bus voltage regulator, (named REPORT).

5666 (TKK-S/SM–1989/21, pp. 54-60) **Object oriented power system modelling.** Seppaelae, A. (Association of Finnish Electric Utilities, Helsinki (Finland)). Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Electromechanics. 1989. (CONF-8901144–: Symposium on electrical power engineering at the Helsinki University of Technology, Espoo (Finland), 27 Jan 1989). In *Symposium on electrical power engineering.* 130p. Order Number DE93711132. Source: OSTI; NTIS.

Object-oriented programming languages have become popular in artificial intelligence systems. This is an introduction to concepts of object-oriented programming applications on medium-voltage and low-voltage distribution networks. The components of the network are represented as objects. Object is a basic data structure, where the functions and data of network components are bound together. The objects interact by sending messages. Flow of voltage, current, power and other information through the network can be simulated by message sending between objects. Object-oriented programming brings an advanced method to build network models for new applications. The functions studied this far are rather conventional network calculations. The aim of this paper is to rise interest on developing new decision support systems using object-oriented programming tools to handle the complexity and logic of electricity distribution networks.

2402 Power System Networks, Transmission and Distribution

Refer also to citation(s) 7137

5667 (ETDE-IT–92-101) **ENEL high and medium voltage electrical substations for power supply to urban centers.** Bargigia, A.; Boatto, C.; Di Mario, A.; Fava, N.; Sciarra, S.; Speziali, R. Ente Nazionale per l'Energia Elettrica, Milan (Italy). Centro di Ricerca Elettrica; Ente Nazionale per l'Energia Elettrica, Rome (Italy). Dec 1991. 31p. (In Italian). (CONF-9112143–3: Alimentazione elettrica delle grandi aree urbane, Milan (Italy), 10-11 Dec 1991). Order Number DE93748422. Source: OSTI; NTIS (US Sales Only); INIS.

Modular high and medium voltage gas insulated electrical substations are being used by ENEL (Italian Electricity Board) to meet the specific needs of urban centers with special design and sizing constraints of a historical/architectural nature. This paper illustrates the key design, construction operation and performance characteristics of these standardized units. The descriptions include brief notes on equipment-transformer interconnection, interchangeability and environmental compatibility. Performance test procedures and results of actual reliability and certification tests on some substations are reported.

5668 (TKK-S/SM–1989/21, pp. 35-42) **Torsional interaction between HVDC link and large turbine-generators.** Hirvonen, R. (Imatran Voima Oy, Vantaa (Finland). Electrotechnical Dept.). Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Electromechanics. 1989. (CONF-8901144–: Symposium on electrical power engineering at the Helsinki University of Technology, Espoo (Finland), 27 Jan 1989). In *Symposium on electrical power engineering.* 130p. Order Number DE93711132. Source: OSTI; NTIS.

The control system of HVDC link can excite torsional oscillations in turbine-generators. The amount of oscillations and torsional stress depends on the control system parameters of HVDC link, parallel AC transmission system and mechanical parameters of the turbine generator.

5669 (TKK-S/SM–1989/21, pp. 61-68) **An electric power system steady-state monitoring complex.** Sild, A. (Tallinn Technical Univ. (Estonia). Dept. of Power Systems). Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Electromechanics. 1989. (CONF-8901144–: Symposium on electrical power engineering at the Helsinki University of Technology, Espoo (Finland), 27 Jan 1989). In *Symposium on electrical power engineering.* 130p. Order Number DE93711132. Source: OSTI; NTIS.

Problems of ensuring power system steady-state control with relevant information are tackled here. State estimation, analysis, forecast and simulation of power system load flow are observed as parts of a power system steady-state moritoring complex. Mathematical model of power system's time behavior forming the basis of the complex is described.

5670 (TKK-S/SM–1989/21, pp. 69-80) **A computer program for simulation of dynamic phenomena in high voltage networks.** Bastman, J. (Tampere Univ. of Technology (Finland)); Janhonen, S.; Jyrinsalo, J. Helsinki Univ. of Technology, Otaniemi

(Finland). Lab. of Electromechanics. 1989. (CONF-8901144–: Symposium on electrical power engineering at the Helsinki University of Technology, Espoo (Finland), 27 Jan 1989). In *Symposium on electrical power engineering.* 130p. Order Number DE93711132. Source: OSTI; NTIS.

A computer program called TEVA for calculation of various disturbances in high voltage networks is presented. The program is suitable for the simulation of frequency disturbances in three-phase systems, loss of generator or load units, short circuits, removals and automatic reclosures of lines and transformers, etc. The program is running on a VAX 8800 computer and was written in the FORTRAN-77 programming language. Tests have indicated that the results are reasonably consistent with those of a commercially available program. The program is being used to study the behaviour under disturbances of the 110 kV network of Tampere city. A new power plant was newly connected to the network. In this paper also some results of these studies are presented.

5671 (VTT-TIED–1350) **Computational positioning of failures in electricity distribution networks: Two and three phase short-circuits.** Lehtonen, M. (Technical Research Centre of Finland, Espoo (Finland). Lab. of Electrical and Automation Engineering). Technical Research Centre of Finland, Espoo (Finland). 1992. 73p. (In Finnish). Order Number DE93752859. Source: OSTI; NTIS.

Two and three phase short-circuit positioning technology and accuracy of different cases in radial distribution networks are studied in this research. Different factors, e.g. behaviour of the short-circuit current, properties of measuring transformers and errors of the electronics of the measuring devices, effecting on the accuracy of computational positioning are estimated in the beginning of the report. When the failure positioning is based only on the measurement of failure currents, the results are effected by the magnitude of the failure resistance. Additionally, in some cases the current of load of the network during the failure might effect on the results. The accuracy of short-circuit positioning was studied using both current and voltage measurement and plain current measurement, divided into cases in which the measurement is made either in the beginning of the faulty wire or in the cell of the feed-transformer. When the measurements of both voltage and current are available, the effect of load-current can be compensated so that the difference between measurements from the wire and transformer does not become too high. The positioning error of long distance faults is about 5 % of the fault-distance. If only the current measurement is available, it is only possible to estimate the maximum fault-distance. The actual fault-distance can be about 10-15 % shorter than calculated due to fault-currents. Additionally, the other factors causes a maximum error of 7 %, which must be added into the error of fault-resistance. In addition to short-circuits, a short review is given on positioning of ground contacts.

2404 Health and Safety

Refer also to citation(s) 5665

5672 (IMM–6-92) **Magnetic fields and cancer in people residing near Swedish high voltage power lines.** Feychting, M.; Ahlbom, A. Karolinska Inst., Stockholm (Sweden). Inst. of Environmental Medicine. 1992. 100p. Order Number DE93753067. Source: OSTI; NTIS.

Also available from Institutet foer Miljoemedicin, Box 60208, S-10401 Stockholm, Sweden.

The study was designed as a case-control study, based on the population comprised of everyone who have lived on a property located within 300 meters from any of the 220 and 400 kV power lines in Sweden during the period from 1960 through 1985. For adults it was required that the duration of residence was at least one year. The corridor was chosen to be wide enough to ensure that it included both exposed and unexposed homes. The cases were all instances of cancer diagnosed between 1960-85. For children, all types of cancer were included, while for adults the study was restricted to leukemia and brain tumors. The controls were matched to the cases on time of diagnosis, age, sex, parish, and power line. Exposure was assessed in several different ways. First, spot measurements were performed in the homes of the subjects. Second, the magnetic fields generated by the power lines were calculated by means of a computer program taking distance, line configuration, and load into account. For childhood leukemia and with cut off points at 0.1 and 0.2 μT, the relative risk (RR) increased over the two exposure levels and was estimated at 2.7 (95% c.l.: 1.0-6,3) for 0.2 μT and over. The test for trend gave a p-value of 0.02. When the upper cut off point was shifted to 0.3 μT the RR was instead 3.8 (1.4-9.3) and the corresponding trend test gave a p-value of 0.005. In adults and for magnetic fields of 0.2 μT and over, the RR for acute myeloid (AML) and chronic myeloid leukemia (CML) were estimated at 1.7 (0.8-3.5) and 1.7 (0.7-3.8), respectively. This result persisted in most analyses. For brain tumours no association was seen. The results provide support for the hypothesis that exposure to magnetic fields increase the risk of cancer. This is most evident in childhood leukemia. What aspect of the fields that might be involved remains unclear. (6 figs., 82 tabs., 16 refs.).

2405 Environmental Aspects

Refer also to citation(s) 5667, 6784, 6785

5673 (DOE/EA–0595) **Environmental assessment for the new looped power system on Rainier Mesa.** USDOE Nevada Field Office, Las Vegas, NV (United States). 26 Aug 1992. 23p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93002195. Source: OSTI; NTIS; INIS; GPO Dep.

The Nevada Test Site (NTS) is the single location within the continental United States where tests involving nuclear explosive devices are conducted. The NTS is a land mass of 1,350 square miles. It is located 65 miles northwest of Las Vegas, Nevada, on the eastern edge of the Great Mohave Desert in high desert country where altitude ranges from 3,500 feet to approximately 7,700 feet. It is in a remote, isolated and sparsely populated area. The proposed action supports the underground nuclear weapons test program conducted on the NTS as defined in the Nevada Test Site Final Environmental Impact Statement, dated September 1977. The project involves the construction of a new looped power system, to be performed in three phases, indicated on Rainier Mesa in Area 12 at the NTS. The phases are described in this paper.

2407 Economic, Industrial, and Business Aspects

Refer also to citation(s) 4941, 5342, 5743, 5846

25 ENERGY STORAGE

2506 Thermal

Refer also to citation(s) 5787

5674 (ETDE-mf–93750301) **Test rig for the investigation of operating and control concepts for ice storage systems.** Brunk, M.F.; Peschen, P. Turbon-Tunzini Klimatechnik GmbH, Bergisch Gladbach (Germany); Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Mar 1991 156p. (In German). Contract BMFT 0328829A. Order Number DE93750301. Source: OSTI; NTIS (US Sales Only).

The ice storage test rig erected according to the ice constructor system has been investigated in detail with regard to its capacity and operating behavior. It could be confirmed that the storage capacity is exceeded. In three hours, a full discharge has been proven with a small decrease in efficiency. In addition, sensible heat is available. The ice distribution via the bundle of pipes admitted with refrigerants is very constant. The operating experience shows that a regular full discharge is necessary for the maintenance of a constant ice distribution. This makes high demands on the operation management. For reasons of operation and economy the ice storage priority operation has to be preferred. A theoretical consideration and operating experiences with the system certify the correctness of this demand. For the realization a reliable measurement of the storage capacity is necessary. The ice constructor system facilitates this in a simple and exact way. (orig./BWI).

5675 (VTT-TIED–1335) **Water filled, uninsulated heat storages in rock: Usability study.** Vaeaetaeinen, A. (Technical Research Centre of Finland, Espoo (Finland). Road, Traffic and Geotechnical Lab.); Ritola, J.; Sipilae, K. Technical Research Centre of Finland, Espoo (Finland). 1992. 76p. (In Finnish). Order Number DE93752856. Source: OSTI; NTIS.

Research concerning possibilities of heat storage in uninsulated, water-filled rock caverns has been actively going on from the 1980's in Finland. In Sweden, where the bedrock and the system of energy production are alike those in Finland there are, already, several rock storages in operation. All the storage studies here have functioned well technically. Any severe risks of rock unstability have not existed in the accurate temperatures (under 100 deg C). Precipitation and liquidation problems have been successively solved with filters. water processing and special materials in certain parts of equipment and pipelines. Heat losses from the storages have been about 10-25 % in the stationary state. The risks for extra heat losses observed in two storages seem to be connected with the water tunnels above the storage spaces and the probably existing fracture zones between the space and the tunnel. The storages constructed by the moment are individual cases and remarkable amounts of public financial support and research activities have been directed to them. So, final conclusions of costs of storage projects can't be drawn. Nevertheless, a Finnish feasibility study on an old gasoline cavern to be converted into a heat storage has proved the project economical and promising. From the rock mechanical, technical and environmental point of view, on the basis of the experience got from the Swedish storages as well, construction of underground heat storages in Finland seems possible and argumented.

2509 Batteries

Refer also to citation(s) 5280, 5891, 5892, 6058, 6074

5676 (SAND–92-1835C) **DOE battery program for weapon applications.** Clark, R.P.; Baldwin, A.R. Sandia National Labs., Albuquerque, NM (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930152–1: 8. annual battery conference on applications and advances, Long Beach, CA (United States), 12-14 Jan 1993). Order Number DE93002476. Source: OSTI; NTIS; GPO Dep.

This report discusses the Department of Energy (DOE) Weapons Battery program which originates from Sandia National Laboratories (SNL) and involves activities ranging from research, design and development to testing, consulting and production support. The primary customer is the DOE/Office of Defense Programs, although work is also done for various Department of Defense agencies and their contractors. The majority of the SNL activities involve thermal battery (TB) and lithium ambient temperature battery (LAMB)technologies. Smaller efforts are underway in the areas of silver oxide/zinc and nickel oxide/cadmium batteries as well as double layer capacitors.

2540 Legislation and Regulations

Refer also to citation(s) 5892

29 ENERGY PLANNING AND POLICY

5677 (DOE/CE/27504–8) **A beginners guide for video production.** Urban Consortium for Technology Initiatives (United States). Energy Task Force; Public Technology, Inc., Washington, DC (United States); Seattle City Office for Long-Range Planning, WA (United States). Nov 1991. 31p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90CE27504. Order Number DE93005614. Source: OSTI; NTIS; INIS; GPO Dep.

The Seattle-King County Hazardous Waste Management Plan provides the framework for an intensive effort to keep Household Hazardous Waste (HHW) and Small Quantity Generator (SQG) wastes from entering the municipal solid and liquid waste streams. Many innovative programs for managing small sources of hazardous waste have been developed in response to the Plan. With the assistance of Urban Consortium grants, the City of Seattle has researched and developed a series of reports describing the planning, operation and evaluation of the plan's HHW collection programs. Three of the Plan's programs of particular interest to other jurisdictions are the fixed site and mobile HHW Collection Facilities, and the Business Waste Consultations provided to SQG's. In 1991, Seattle received an Urban Consortium grant to produce two videos showing how the HHW Collection Facilities and Business Consultations programs work. This report provides an overviews of the video development and production process and a discussion of the lessons learned by the staff directing the production.

5678 (DOE/ER/75682–1-Pt.6) **Kansas Energy 2000: Inventory of energy related assets, Research area summary – Kansas State University, University of Kansas, Wichita State University: Volume 2.** Legg, J.; Nellis, D.; Simons, G. Kansas State Univ., Manhattan, KS (United States). Inst. for Social and Behavioral Research. Mar 1992. 169p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER75682. Order Number DE93001490. Source: OSTI; NTIS; GPO Dep.

The Inventory of Energy Related Assets: Research Area Summary is a compilation of resume-type information on energy researchers in the state of Kansas. Researchers are placed in one of four categories: Fossil Energy Research, Alternative Energy Sources, Electric Power Generation and Usage, and Other Energy Research. Each research biography includes a synopsis of recent research, sources of support, and areas of research emphasis.

5679 (DOE/ST–0002P) **Capsule review of DOE research and development laboratories and field facilities.** USDOE Assistant Secretary for Defense Programs, Washington, DC (United States). Office of Science and Technology Advisor. Sep 1992. 140p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93003282. Source: OSTI; NTIS; GPO Dep.

This report provides an overview of the unique complex of research, technical development, manufacturing, and administrative facilities that comprise the US Department of Energy (DOE) field installations. FY 1991 budget for the entire complex was over $15 billion. There are approximately 137,000 employees working within the complex. Approximately 4% of these are Federal employees; the remainder are employed and managed under contracts with industry and universities. Originating in the Manhattan Project of World War II, the DOE field facilities system has developed in several major directions. It includes the largest uranium enrichment and special nuclear materials production complex in the free world; its manufacturing facilities provide the nuclear devices for the national strategic defense system; and it develops the nuclear reactors that power the submarine fleet of the US Navy. Equally important is the growth of the scientific and technological capabilities of the system. The original concentration on nuclear physics has been broadened to encompass the entire spectrum of the fundamental sciences. Research in DOE laboratories now spans investigations into the nature of matter and chemical reactions, cosmology, the operation of biological cells, the process of genetic information coding, the ecosystem, the geosphers, mathematics and computing, and medicine. Nearly every area of basic scientific knowledge is represented in the research activities of the laboratories within the DOE field system. The 9 multiprogram laboratories and 21 program-dedicated laboratories accomplish the fundamental scientific work of the DOE field system and also the bulk of the research and development. They account for approximately 60% of the total field budget and employ nearly 69,000 people. More than ham of these are scientists, engineers, and technicians.

5680 (ETDE-mf–93744298) **Historical survey of the activities of the regional corporations in the public utilities area in the five new Laender.** Jacobi, K.O. Verband Kommunaler Unternehmen e.V., Koeln (Germany). 1992 101p. (In German). Order Number DE93744298. Source: OSTI; NTIS (US Sales Only).

A paper published last year on the municipal utilities as they used to exist on the territory of the former German Democratic Republic and a contribution that has been revised and supplemented accordingly offered interesting insights into the municipal supply structures of the past. The municipal utilities were converted into

collective combines at the beginning of the fifties, as were incidentally other sectors of the economy. The continued discussion on the demands of the communities on the municipal works for restitution in kind has recently also brought up the question as to a participation of the communities and the Laender in former regional and/or horizontally integrated utilities in the area of electricity generation and distribution. (orig./UA).

2901 Energy Analysis and Modeling

Refer also to citation(s) 5712

5681 (ECN-I–92-037) **EFOM-ENV/GAMS Interface: User's guide.** Roos, A.L. Netherlands Energy Research Foundation (ECN), Petten (Netherlands). Jul 1992. 81p. Order Number DE93752677. Source: OSTI; NTIS (US Sales Only).

EFOM-ENV (Energy Flow and Optimization Model - ENVironment) is a linear programming model which models national energy systems. It improves the flexibility the Netherlands Energy Research Foundation specified EFOM-ENV in GAMS. GAMS (General Algebraic Modelling System) is a modelling language, especially developed for large and complicated models. GAMS can also be applied on a work station and personal computer. The EFOM-ENV/GAMS interface checks the data at input time, and will not accept illegalities. The basis of the interface is a form, accomodated to EFOM-ENV, to be completed by the user. The form contains all the necessary data of a PROCESS, the most disaggregated level of an energy conversion technology. Also the data of related UNITS, energy carriers and abatement technologies can be entered on overlayed forms, which pop up on request or in some cases are prompted when data is needed. The EFOM-ENV/GAMS interface is a self-explanatory, menu-driven program. In this manual a detailed description is given of every possible input with its restrictions.

5682 (ETDE-mf–93744301) **A disaggregated econometric model for the Federal Republic of Germany to evaluate economic effects of environmental policy.** Universitaet Bielefeld, Fakultaet fuer Wirtschaftswissenschaften. Discussion Paper. Frohn, J. Bielefeld Univ. (Germany). Fakultaet fuer Wirtschaftswissenschaften. Dec 1990 80p. Order Number DE93744301. Source: OSTI; NTIS (US Sales Only).

The political discussion is very much concerned with the question whether measures of environmental policy will mainly cause negative economic effects or positive economic effects. In most cases a specific environmental action will have both effects. Therefore it is necessary to try to evaluate the economic net effect of such measures. In the study which is described below an econometric model was specified on the basis of a time-series of input-output-tables which allows a simultaneous evaluation of positve and negative effects. The paper is organized as follows: In section 2 the general concept of the model will be described. In the following paragraphs 3, 4, 5 and 6 the different parts of the model: final demand, production, prices, and income are discussed and the main estimation results are documented. In the conclusion some results of the first simulation experiments are given. (orig.).

5683 (ETDE-mf–93750624) **Energy strategies from the view of system management.** Diskussionspapiere Fachbereich Wirtschaftswissenschaften, Universitaet Hannover. Mueller, U.; Pasche, M.; Irrek, W. Hannover Univ. (Germany). Fachbereich Wirtschaftswissenschaften. 1992 67p. (In German). Order Number DE93750624. Source: OSTI; NTIS (US Sales Only).

After an introductory explanation of the significance of system management and a short view on the organization of energy flow in the biosphere, objectives for energy strategies are discussed. Finally, consequences for energy management from the view of system management are presented (consequences for the optimization of energy flow, energy source utilization, as well as consequences for policy and management). (UA).

2902 Economics and Sociology

Refer also to citation(s) 5116, 5682, 5689, 5718, 5722, 5737, 5758, 5900, 6021, 6549

5684 (ETDE-mf–93742624) **Energy and communication. Country report FRG.** Studies on risk communication. Wiedemann, P.M.; Henschel, C. Forschungszentrum Juelich GmbH (Germany). Programmgruppe Mensch, Umwelt, Technik (MUT). Dec 1991 23p. Order Number DE93742624. Source: OSTI; NTIS (US Sales Only).

At its meeting in Montreal in 1989, the World Energy Conference set up a technical committee to promote a multi-national comparative study on communication policy on energy issues. The committee's goal was to identify the main controversies and debates on energy, communication targets and strategies, as well as the main participants in energy communication policy. The following paper is the report of the Federal Republic of Germany. The comparative study will be issued at the 15th WEC congress in 1992. (orig./UA).

5685 (ETDE-mf–93742658) **On the energetical aspect of the consequences of technology.** Technische Universitaet Chemnitz, Sektion Verarbeitungstechnik. Preprint. Weise, H.; Lorenz, A.D. Technische Univ. Chemnitz (Germany). Sektion 9 - Verarbeitungstechnik. 1991 13p. (In German). Order Number DE93742658. Source: OSTI; NTIS (US Sales Only).

Given the qualifying definition that cost-entailing consequences of technology (CCT) are primarily irreversible disturbances of unquestionably vital states of equilibrium in the developmental process of the interactions between man and nature and between the individual and society the question can be raised as to the costs caused by CCT, i.e. the expenditure of human effort and natural resources permissible for correcting or compensating imbalances thus caused. The monetary aspect of these costs is used without restriction as a measure, in spite of the difficulties this entails in practice. The aim is defined as the unity of redress of manifest and avoidance of future CCT as far as this is possible within the scope of present knowledge. Technology always involves enrgy and consequences of technology (CT) are therfore also always quantifiable in terms of enrgy, in other words there is always a material and an energetical aspect of such CT. This study mainly deals with the energetical aspect of such CT and attempts to define qualitative borders within which comensation remains permissible (developmental borders) (orig.).

5686 (NEI-DK–988) **Some effects of energy taxes on national welfare.** Skriftserie K. Nationaloekonomisk Institut, 17. Bentzen, J. Handelshoejskolen i Aarhus (Denmark). Nationaloekonomisk Inst. Jun 1992. 22p. (In Danish). Order Number DE93752759. Source: OSTI; NTIS.

The aim was to use a simple model as a basis for gathering and discussing some central points in the debate on the advantages and disadvantages of energy taxation in relation to, for example, Denmark's economy. These points could be the negative effects on resource utilization that arise when renewable energy is indirectly subsidized via taxation on oil, and on the other hand the advantages of stability of prices and supply. The conclusions of the model are restricted by the preliminary conditions and therefore are not in any way surprising. The main goal was to survey the "losses" (non-optimal resource locating, or promotion of "expensive" renewable energy sources) and "gains"(supply stability and more stable prices). The conditions are described and the model constructed, and then the problems, first for an oil importing economy and after this for a situation where the economy changes to comprise oil exporting (in other words a situation like the Danish one) are discussed. The actual development in oil prices and economy are then dealt with by setting up a simple test relating to the possible connections between oil price and economic development. (AB).

5687 (NEI-DK–1025) **District heating tariff study for the Polish energy sector: Summary report.** Danish Board of District Heating (DBDH), Odense (Denmark). Consult Poland. Aug 1992. 65p. Contract IMOe-482. Order Number DE93752752. Source: OSTI; NTIS.

The tariff study was initiated by the World Bank and is expected to contribute to the process of restructuring the Polish energy sector. The overall objective of the restructuring is to improve economic efficiency in the supply and use of energy. It will also involve changes in the regulatory framework, governance and ownership. The objective of the study was to provide operational guidelines

and recommendations for Polish district heating tariffs in the perspective of a national energy policy and including a legal framework, other regulations, subsidies and taxes. A detailed presentation of tariffs and legal measures in Western Europe (mainly related to Denmark) is followed by proposals related to the Polish scene. Tariffs should ensure that utilities recover all costs and that the overall energy policy is implemented. It is part of a financial relation between a seller and a buyer of heat. The specific tariff must be defined by the parties involved in accordance with policy, legislation, organization and technology. Detailed recommendations are given on the legal framework and regulations, incentives and general tariff principles. It is advised that using fuel taxes and subsidies as energy-saving measures should be considered. Tariffs should be incentives to the involved parties to work for overall least-cost solutions. Tariff regulations in the Polish district heating sector should be general, leaving details, and individual adjustments of tariffs and contracts to local conditions, to the local companies. (AB).

5688 (NUTEK-R–92-25) **The balance principle.** Pedersen, L. (Megaliten Konsult AB (Sweden)); Johansson, Bengt; Lindahl, A.; Bowie, R. Swedish National Board for Industrial and Technical Development (NUTEK), Stockholm (Sweden). 1992. 79p. (In Swedish). Order Number DE93753059. Source: OSTI; NTIS.

The balance principle is the term used in Scandinavia for optimum use of resources in energy supply and use to the lowest cost possible; i.e. much like IRM/LCP in the US. In this report the theoretical basis and possible applications in Sweden of BP are discussed, especially cost and income conepts and the time perspective. Energy markets are described in US, where IRP was initiated, and in Sweden today and in future, after deregulation. Application of BP in Sweden will differ from IRM in US due to different market structure especially in the future when/if the utilities will compete on the market. Technical aspects on IRM/LCP in US are given in an appendix. (44 refs., 6 figs.).

2903 Environment, Health, and Safety

Refer also to citation(s) 5126, 5217, 5682, 6475, 6589, 7432, 7510, 7511

5689 (ANL/EAIS/CP–77888) **Regional differences in the potential exposure of US minority populations to hazardous facilities.** Nieves, L.A. (Argonne National Lab., IL (United States)); Nieves, A.L. Argonne National Lab., IL (United States). [1992]. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9211139–1: Annual meeting of the Regional Science Association International (RSAI), Chicago, IL (United States), 15 Nov 1992). Order Number DE93004155. Source: OSTI; NTIS; GPO Dep.

In the literature that examines the distribution of environmental disamenities of various types, there is considerable documentation that minority groups and lower income groups are more likely to be exposed. Such differential exposure has been attributed to "environmental racism" by some authors, but there has been no systematic investigation of the factors and dynamics underlying this exposure pattern. This study examines regional differences in the proximity of African-American, Hispanics, Asians, and non-Hispanic Whites to a broad range facility types and explores the degree to which this may be related to urban and income factors.

5690 (DOE/EA–0523) **Longview District Operations and Maintenance Headquarters: Environmental assessment.** USDOE Bonneville Power Administration, Portland, OR (United States). Mar 1992. 11p. Sponsored by USDOE, Washington, DC (United States). (DOE/BP–1791). Order Number DE93002205. Source: OSTI; NTIS; INIS; GPO Dep.

Bonneville Power Administration (BPA) operations and maintenance staff are presently based at a headquarters next to the Longview Substation. These headquarters buildings, however, were built in 1941 and have deteriorated to the point of needing extensive repair. They also lack sufficient inside storage space. New buildings cannot be constructed on the site because of surrounding development. In addition, the site is within an area exposed to industrial fallout (coal tar pitch and metallic particles) that may be damaging buildings, equipment, and vehicles. BPA is concerned about the potential health risk to headquarters staff from the fallout. In light of these problems, BPA proposes to construct a new operations and maintenance headquarters at a different location, and to demolish the existing headquarters. This paper discusses the environmental impacts of the proposed action and alternatives.

5691 (DOE/EA–0696) **Construction of temporary mobile office complex in the 200 West Area, Hanford Site, Richland, Washington: Environmental assessment.** USDOE, Washington, DC (United States). Jun 1992. 16p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93002206. Source: OSTI; NTIS; INIS; GPO Dep.

This environmental assessment provides the necessary information so that a decision can be made concerning the proposed action on whether a Finding of No Significant Impact should be issued or an environmental impact statement should be prepared. The proposed action is the construction and operation of a temporary mobile office and changeroom complex in the 200 West Area of the Hanford Site. Therefore, this environmental assessment evaluates the proposed action and alternatives, including a no action alternative, in keeping with requirements of the Natior.al Environmental Policy Act (NEPA) of 1969, and regulations of the Council on Environmental Quality, Title 40, Code of Federal Regulations (CFR), Part 1500.

5692 (DOE/EH–0181/0992-RCRA) **Loss of interim status (LOIS) under RCRA: RCRA information Brief.** USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (United States). RCRA/CERCLA Div. Sep 1992. 2p. Sponsored by USDOE, Washington, DC (United States). Source: OSTI (Free of Charge).

The Resource Conservation and Recovery Act (RCRA) requires owners and operators of facilities that treat store, or disposal of hazardous waste (TSDFs) to obtain an operating permit. Recognizing that it would take EPA many years to issue operating permits to all RCRA facilities, Congress created "interim status" under Section 3005(e) of the Act. Interim status allows facilities to operate under Subtitle C of RCRA until their permits are issued or denied. This information brief defines interim status and describes how failure to meet interim status requirements may lead to loss of interim status (LOIS).

5693 (DOE/EH–0274) **Preparation of RCRA contingency plans.** USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (United States). RCRA/CERCLA Div. Jul 1992. 109p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93001471. Source: OSTI; NTIS; GPO Dep.

The purpose of this guidance is to assist Department of Energy (DOE) field personnel in the preparation of Resource Conservation and Recovery Act (RCRA) contingency plans as set forth in 40 CFR 264/265 Subpart D and 270.42. The guidance will assist personnel in evaluating and ensuring facility compliance with the contingency plan requirements.

5694 (DOE/EIS–0157) **Mitigation Monitoring and Reporting Program for continued operation of Lawrence Livermore National Laboratory.** California Univ., Livermore, CA (United States). Aug 1992. 35p. Sponsored by USDOE, Washington, DC (United States). (SCH–90030847). Order Number DE93003127. Source: OSTI; NTIS; GPO Dep.

A Mitigation Monitoring and Reporting Program, required by the California Environmental Quality Act, was developed by UC as part of the Final EIS/EIR process. This document describing the program is a companion to the Final Environmental Impact Statement/ Environmental Impact Report (EIS/EIR) for the Continued Operation of Lawrence Livermore National Laboratory (LLNL) and Sandia National Laboratories, Livermore (SNL, Livermore). The Final EIS/ EIR analyzes the potential environmental impacts of the proposed action, which for the purposes of NEPA is: continued operation, including near-term (within 5 to 1 0 years) proposed projects, of LLNL and SNL, Livermore. The proposed action for the EIR is the renewal of the contract between DOE and UC for UC's continued operation and management of LLNL. The Mitigation Monitoring and Reporting Program is for implementing and monitoring progress of measures taken to mitigate the significant impacts of the proposed

action. A complete description of the impacts and proposed mitigations is in Section 5 of Volume I of the Final EIS/EIR. This report summarizes the mitigation measures, identifies the responsible party at the Laboratory for implementing the mitigation measure, states when monitoring will be implemented, when the mitigation measure will be in place and monitoring completed, and who will verify that the mitigation measure was implemented.

5695 (EGG-EP–10296) **The impact of electric vehicles on CO_2 emissions: Final report.** Bentley, J.M. (Little (Arthur D.), Inc., Cambridge, MA (United States)); Teagan, P.; Walls, D.; Balles, E.; Parish, T. EG and G Idaho, Inc., Idaho Falls, ID (United States); Little (Arthur D.), Inc., Cambridge, MA (United States). May 1992. 103p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93003719. Source: OSTI; NTIS; INIS; GPO Dep.

A number of recent studies have examined the greenhouse gas emissions of various light duty vehicle alternatives in some detail. These studies have highlighted the extreme range of predicted net greenhouse gas emissions depending on scenarios for fuel types, vehicle and power generation efficiencies, the relative greenhouse contributions of emitted gases and a number of uncertainties in fuel chain efficiencies. Despite the potential range of results, most studies have confirmed that electric vehicles generally have significant potential for reducing greenhouse gas emissions relative to gasoline and most alternative fuels under consideration. This report summarizes the results of a study which builds on previous efforts with a particular emphasis on: (1) A detailed analysis of ICEV, FCV, and EV vehicle technology and electric power generation technology. Most previous transportation greenhouse studies have focused on characterization of fuel chains that have relatively high efficiency (65–85%) when compared with power generation (30–40%) and vehicle driveline (13–16%) efficiencies. (2) A direct comparison of EVs, FCVs with gasoline and dedicated alternative fuel, ICEVs using equivalent vehicle technology assumptions with careful attention to likely technology improvements in both types of vehicles. (3) Consideration of fuel cell vehicles and associated hydrogen infrastructure. (4) Extension of analyses for several decades to assess the prospects for EVs with a longer term prospective.

5696 (ETDE-mf–93742657) **The implementation of the Federal Law on Environmental Impact Assessment in Rheinland-Pfalz.** Universitaet Kaiserslautern, Studiengang Raum- und Umweltplanung, Lehr- und Forschungsgebiet Regional- und Landesplanung. Werkstattbericht. Hennecke, F. Kaiserslautern Univ. (Germany). Fachbereich Architektur, Raum- und Umweltplanung, Bauingenieurwesen. 1991 15p. (In German). Order Number DE93742657. Source: OSTI; NTIS (US Sales Only).

The report gives a comprehensive insight into the inquiries conducted in Rheinland-Pfalz under the supervision of the author into the necessities, possibilities and problems that have crystallized during the implementation of the Federal EIA Law in Rheinland-Pfalz. Altogether the contours of the envisaged concept for implementing the environmental impact assessment show that the old controversies in this issue continue to exist. It appears that the previous administrative practice is to be continued on the grounds that together with the law hitherto in force it has always provided for environmental impact assessments in the part, e.g. in connection with area development planning it is further argued that as there is no need to introduce EIA, specification of this would be a useful aim. The basic weakness of the EIA Law is expected to become manifest in the implementation of the Federal Emission Control Law: as it essentically consists in the weighing of facts, the environmental impact assessment cannot be incorporated into a licensing pocedure which under the Federal Emission Control Law is bound to facts only. (orig./HSCH).

5697 (ETDE-mf–93744268) **Federal Government decision on the reduction of CO_2-emissions in the Federal Republic of Germany until 2005.** Umweltpolitik. Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany). Mar 1991 104p. (In German). Order Number DE93744268. Source: OSTI; NTIS (US Sales Only).

Results of consultations of the interministerial group 'CO_2-reduction' are presented. The documentation consists of four parts: 1. cabinet task, 2. cabinet decision, 3. sum total of working group production to date, 4. study group reports. (UA).

5698 (ETDE-mf–93744300) **On problems of indemnification for the 'new type' of forest damage.** Arbeitsbericht aus dem Institut fuer Oekonomie, Bundesforschungsanstalt fuer Forst- und Holzwirtschaft. Kueppers, J.G. (Bundesforschungsanstalt fuer Forst- und Holzwirtschaft, Hamburg (Germany). Inst. fuer Oekonomie); Thoroe, C. Bundesforschungsanstalt fuer Forst- und Holzwirtschaft, Hamburg (Germany). Aug 1991 17p. (In German). Order Number DE93744300. Source: OSTI; NTIS (US Sales Only).

Complaints about outstanding regulations on indemunification or compensation for forest damage caused by air pollution ofter overloock the fact that a whole row of remedial measures has already been initiatied. They also frequently show no appreciation of the difficulties involved in finding a new ruling for compensating and supportive measures that is both fair and practicable. The report outlines the field of the determination and valuation of damages in connection with forest damages caused by air pollution. The forest owners concerned receive considerable financial aid through a row of forest-political measures. Tax privileges pursuant to article 34b of the Income Tax Law lead to substantial tax relief in individual cases. The search for practicable rulings on compensation for damages has brought up the idea of treating the issue in a wider context. Besides the financial aspect, an ouverall assessment of forest damages caused by air pollution should also consider the diverse social functions of the forest. This widens the spectrum of forest - political concepts for compensation and support. A general search for ways of improving the economic situation of forest enterprises seems expedient. The growing debate about differentiated surface premiums as part of the forthcoming agricultural reform should be taken aa an incentive to intensify such deliberations. (orig./HSCH).

5699 (ETDE-mf–93744309) **Abatement of energy-related CO_2 emissions in the Federal Republic of Germany. Resolution of the German Federal Government on the abatement of energy-related CO_2 emissions in the Federal Republic of Germany based on the Second Intermediate Report of the Interministerial Study Group 'CO_2 abatement' (IMA CO_2-Redktion).** Umweltpolitik. Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany). Jan 1992 97p. (In German). Order Number DE93744309. Source: OSTI; NTIS (US Sales Only).

Resolution of the German Federal Government on the abatement of energy-related CO_2 emissions in the Federal Republic of Germany based on the Second Intermediate Report of the Interministerial Study Group 'CO_2 Abatement' (IMA CO_2-Reduktion). The Interministerial Study Group 'CO_2 Abatement' submitted its Second Intemediate Report to the cabinet on 11 December 1991. Working from this report the German Federal Government has expressly reasserted its a aim of a 25 to 30 per cent reduction of CO_2 emissions by the year 2005 and has approved further-going steps to implement the CO_2 abatement programme. The 25-30 per cent abatement target for the year 2005 is equivalent to an abatement of CO_2 emissions by 300 million tons by the year 2005. The full text of the cabinet's resolution and the likewise approved Second Intermediate Report of the IMA CO_2-Reduktion are presented in the paper. (orig./UA).

5700 (ETDE-mf–93744322) **Necessity for a global environmental policy. The goals of the Federal Republic of Germany at the UNCED in Rio de Janeiro.** Umwelt und Entwicklung. Aus deutscher Sicht. Michaeli, W.D. Inter Nationes e.V., Bonn (Germany). 1992 16p. (In German). Order Number DE93744322. Source: OSTI; NTIS (US Sales Only).

UNCED as the second worldwide conference to be held in Rio de Janeiro from 1st to 12th June 1992 will concern issues of environmental protection. There are at least three fields in which the Federal Government intends to bring about agreements which shall be as concrete as possible: world climate convention; species protection convention; declaration for the protection and conservation of forests. It may not be possible to succeed with all these objectives; nevertheless, it is important that the conference should 'fire the gun for a follow-up-process' which will involve concretization of many agreements. (orig./HSCH).

5701 (ETDE-mf–93744440) **Preparation of a handbook on environmental quality goals and standards as a basis of assessment for animals, plants, and water within the framework of the environmental impact statement in Lower Saxony. Final report.** Fuerst, D.; Knebel, R.; Ratzbor, G. Hannover Univ. (Germany). Inst. fuer Landesplanung und Raumforschung; Umweltministerium des Landes Niedersachsen, Hannover (Germany). [1992] 238p. (In German). Order Number DE93744440. Source: OSTI; NTIS (US Sales Only).

Precautionary care of the environment is not to be achieved by isolated, individual, minimum quality standards for the environment but by an adequate and concrete system of environmental quality goals, respectively standards, at different levels. These quality goals or standards should complement each other with a view to protection targets, and if necessary should make allowance at the lower levels for regional or local particularities. The purpose of this handbook is to document and systematize existing environmental quality goals or standards, or such goals and standards as are to be expected from ongoing work, relating to the application of the environmental impact statement, to establish gaps in the system of existing environmental quality goals and standards as measured by the demends of the environmental impact statement, to work out concrete proposals for closing such gaps, to work out hints regarding the application of quality goals and standards in environmental impact statements according to sections 5 or 6, respectively section 12, of the law on environmental impact statements. (orig./HSCH).

5702 (ETDE-mf–93744484) **Ecological rehabilitation and development in the new states of unified Germany. A resolution passed on the occasion of the 37th Environment Ministers Conference , Leipzig, November 21/22, 1991.** Umweltpolitik. Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany). 1992 89p. (In German). Order Number DE93744484. Source: OSTI; NTIS (US Sales Only).

More than one year after the unification of Germany the autumn conference of the Federal and Land Government Environment Ministers struck the balance of the process of ecological rehabilitation in the new provinces. The report defines the fields to which governmental and regional environmental policies must give priority. The environmental situation clearly improved in 1991. Water, ground and air pollution have been reduced as the process of economic structural changes took its course, outdated production plants were shut down to be replaced by modern facilities, and governmental programs were started to better the former conditions. (orig./HSCH).

5703 (IVL-B–1065) **Regional environmental impact description - a methodological study for the energy production sector.** Loevblad, G.; Skaerby, L. Swedish Environmental Research Inst., Goeteborg (Sweden). Jul 1992. 24p. (In Swedish). Order Number DE93753056. Source: OSTI; NTIS; INIS.

This study is a first pilot test of regional environmental impact description for energy supply and aimed at illuminating problems in performing and using such studies. As a general conclusion it is noted that separate sectors cannot be analyzed in isolation, all sectors (energy, traffic, agriculture, forestry a.s.o) in one region have to be considered together in order to reach environmental targets for regions. (8 refs., 3 figs., 2 tabs.).

5704 (IVL-B–1066) **Description of the state of the environment in a westswedish region in relation to environmental targets.** Loevblad, G.; Skaerby, L. Swedish Environmental Research Inst., Goeteborg (Sweden). Jul 1992. 50p. (In Swedish). Order Number DE93753057. Source: OSTI; NTIS; INIS.

The counties of Goeteborg and Aelvsborg are studied in this pilot work of regional environmental analysis. The region studied is heavily affected by sulfur and nitrogen depositions, also from sources outside the region. National strategies demand severe reductions of sulfur, nitrogen and carbon dioxide emissions for this area, leaving no room for regional environmental planning (27 refs., 1 fig., 20 tabs.).

5705 (Juel–2641) **International greenhouse gas verification. No. 2. Institutional verification problems in the context of an international climate convention.** Comes, S. (Deutsche Gesellschaft fuer Auswaertige Politik e.V., Bonn (Germany). Forschungsinst.). Forschungszentrum Juelich GmbH (Germany). Programmgruppe Technologiefolgenforschung; Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Jul 1992. 104p. (In German). Contract BMFT ET9188A. Order Number DE93744900. Source: OSTI; NTIS (US Sales Only).

After an introductory section with some definitions, the second chapter goes into the problem of why verification tends to be neglected in international environmental protection agreements. The third chapter presents some criteria for the organisational structure of verification institutions. Methods and institutions should be as flexible as possible in order to remove obstacles and shorter delays in the verification process. The fourth chapter shows how this can be done and what organisational structures will result. There is an empirical section in which the applicability of environmental monitoring networks for verification activities at a later stage is investigated. The fifth and final chapter presents a proposal for institutionalisation of verification in the framework of an international climate convention. (orig./KW).

5706 (Juel–2642) **International greenhouse gas verification. No. 3. Theory and practice of the verification of a global climate convention.** Efinger, M. (Koblenz-Landau Univ., Mainz (Germany)); Breitmeier, H. Forschungszentrum Juelich GmbH (Germany). Programmgruppe Technologiefolgenforschung; Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Jul 1992. 90p. (In German). Contract BMFT ET9188A. Order Number DE93744899. Source: OSTI; NTIS (US Sales Only).

A global climate convention will not be effective, in the short or long run, unless the verification problem can be solved satisfactorily for the states which are partners in the convention. The authors intended to find out the exact nature of the verification problem for the problem of global climate change and to present a tentative solution. The main emphasis is on the theoretical problems of verification of a global climate convention. The two authors present their respective experience in the fields of verification and cooperation in disarmament, arms control, and international ecological cooperation, especially for the protection of the Earth's atmosphere. (orig./KW).

5707 (NEI-DK–989) **Better air: How should Denmark prioritize initiatives aimed at an improvement of the atmospheric environment? Final document and presentation from the experts at the consensual conference.** Teknologinaevnet, Copenhagen (Denmark). 1992. 116p. (In Danish). (CONF-9010351–: Conference on better air, Copenhagen (Denmark), 22-24 Oct 1990). Order Number DE93752781. Source: OSTI; NTIS.

The aim of the conference was to determine which are the most significant problems in connection with the improvement of the quality of the air over Denmark, in which areas air pollution is most prominent and how initiatives aimed at air pollution abatement should be prioritized. As a result of this discussion a final document including recommendations from the participating experts on how to limit air pollution and its harmful effects, descriptions of local and regional and global problems and their damaging impacts, and suggestions as to what should be done to ameliorate them, was presented. The document also contains ideas for the control of international initiatives in this respect, and describes the constraints on these initiatives. (AB).

5708 (NEI-DK–989, pp. 45-52) **The subject of energy.** Oelsgaard, P. (ELKRAFT (Denmark)). Teknologinaevnet, Copenhagen (Denmark). 1992. (In Danish). (CONF-9010351–: Conference on better air, Copenhagen (Denmark), 22-24 Oct 1990). In *Better air: How should Denmark prioritize initiatives aimed at an improvement of the atmospheric environment? Final document and presentation from the experts at the consensual conference.* 116p. Order Number DE93752781. Source: OSTI; NTIS.

Since the 1970s, Danish electricity supply has been dependent on imported coal. This has lead to greater reliability of supply, as could be seen during the Gulf War when Danish electricity prices remained stable in contrast to conditions in other countries. The disadvantage is the air pollution caused by coal combustion. This is regulated, it is stated, by several international laws and agreements, and these are named here. The nature of this form of pollution is explained in relation to actual Danish power plants and their efforts to reduce emissions of sulphur dioxide and nitrogen

oxides. Carbon dioxide, which is a greenhouse gas, is also emitted. Danish environmental policy concentrates on these problems. The efforts of the electric power companies to reduce air pollution are detailed, both nationally and internationally, and their positive consequences are described. Desulphurization and denitrification costs are claimed to be 4.6 Danish oere and 1.9 Danish oere per year per kWh respectively. The firm Danish Power Consult has acted as consultant in relation to some power plants in China, resulting in a 15% increase in efficiency, leading to a saving of 300 million tons of coal used, this is about 30 times the amount of Denmarks annual consumption of coal in power plants. (AB).

5709 (NEI-DK–989, pp. 82-93) **Planning, organizing and regulating in relation to the environment.** Basse, E.M. (Institut for offentlig ret, Aarhus Universitet (Denmark)). Teknologinaevnet, Copenhagen (Denmark). 1992. (In Danish). (CONF-9010351–: Conference on better air, Copenhagen (Denmark), 22-24 Oct 1990). In *Better air: How should Denmark prioritize initiatives aimed at an improvement of the atmospheric environment? Final document and presentation from the experts at the consensual conference.* 116p. Order Number DE93752781. Source: OSTI; NTIS.

The importance of coordination of sector, national and international activities aimed at reducing air pollution is stressed. The organization of the decision-making system, a central element with regard to priorizing and control, is clarified and the influence of politics on the decision-making process is discussed. A survey of the regulations relevant to air pollution reduction is presented and the connected competent authorities are exemplified. Strategies for future Danish policy regarding air pollution abatement are discussed. A list of relevant Danish sector ministries and their legal administrative areas and programmes etc. is given. Other authorities relevant to pollution abatement are also listed in addition to the plans which help to concretize the content of the legal regulations. This also makes the areas of competance clear. (AB).

5710 (NEI-DK–989, pp. 101-109) **Economical consequences of various types of regulation.** Birk Mortensen, J. (Oekonomisk Institut, Koebenhavn Universitet (Denmark)). Teknologinaevnet, Copenhagen (Denmark). 1992. (In Danish). (CONF-9010351–: Conference on better air, Copenhagen (Denmark), 22-24 Oct 1990). In *Better air: How should Denmark prioritize initiatives aimed at an improvement of the atmospheric environment? Final document and presentation from the experts at the consensual conference.* 116p. Order Number DE93752781. Source: OSTI; NTIS.

Denmark has a tradition for regulation, based on previous experience within the health sector, for tackling the problem of improvement of the environmental quality by directly using regulations, in the form of standardization. The Danish debate on economic control as a means of improving environmental quality is elucidated and further discussed in detail. Danish policy involves the establishment of tariffs exacted from companies where industrial air pollution exceeds certain limits. This could constrain industrial development and thus be disadvantageous to the country's economy. (AB).

5711 (NEI-DK–1006) **UNEP greenhouse gas abatement costing studies: Analysis of abatement costing issues and preparation of a methodology to undertake national greenhouse gas abatement costing studies. Phase one report.** Christensen, J.M. (UNEP Collaborating Centre on Energy and Environment (Denmark)); Halsnaes, K.; Lim, C.J.C. Jr.; Mackenzie, G.A.; Villavicencio, A.; Morthorst, P.E.; Fenhann, J.; Ghosh, P.; Brink, P. ten, Morrison, M.M.; Grubb, M.J. United Nations Environment Programme, Roskilde (Denmark). Collaborating Centre on Energy and Environment. Aug 1992. 157p. Order Number DE93752805. Source: OSTI; NTIS.

The UNEP (United Nations Environment Programme) programme of Greenhouse Gas Abatement Costing Studies is intended to clarify the economic issues involved in assessing the costs of limiting emissions of greenhouse gases and to propose approaches to comparable costing studies. Phase 1 has consisted of a workshop on the methodological requirements for costing analysis, reviews of the key issues and studies, and a set of preliminary national studies. It was concluded that a description of possible costs imposed by climate change and of measures to adapt to it are needed in addition to assessment of costs of limiting emissions. Issues raised in this respect vary greatly according to country, status of development etc. The task can be politically very sensitive. Assessments should consider implementation, permanent and transitional costs. Macro-economic models are needed for each country. All countries have options for reducing greenhouse gas emissions and energy system costs. Hidden costs exist, and political inertia and opposition from adversely affected groups can prevail. Cost assessment is also a matter of political judgement. Technological assessments that very large savings (50%) are available with direct economical benefit take no account of market obstacles and hidden costs. It appears that long-term 50% reduction in projected global fossil fuel CO_2 emissions could have a long-term global GDP ranging from insignificant to maximum 2.5% reduction. There may be benefits from the use of carbon tax revenues for reducing other taxes. Components for assessment are detailed. (AB).

5712 (NEI-DK–1013) **Integrated energy and environmental planning: interim report.** Bornholms Amtskommune, Roenne (Denmark); Cowiconsult Raadgivende Ingenioerer A/S, Virum (Denmark); Energistyrelsen, Copenhagen (Denmark); Danmarks Tekniske Hoejskole, Lyngby (Denmark); Risoe National Lab., Roskilde (Denmark). May 1989. 50p. Contract TR-88.218;Contract ENS-UVE-90.0072. Order Number DE93752819. Source: OSTI; NTIS.

Also published in Danish.

The progress and current status of the project on integrated energy and environmental planning on Bornholm, a Danish island (area 500 m^2, population 46,105) in the Baltic Sea situated southeast of Copenhagen, is described. The methodology to be used for the planned analyses is explained. The purpose of the project was to analyse energy and environmental problems in a common context in order to suggest coordinated solutions. An overview of the pollution on Bornholm is given, energy and environmental aspects in relation to various changes in the uses of energy resources are evaluated and a plan of action is suggested. A multidimensional basis for decision-making is thus established. (AB).

5713 (NEI-NO–293 A6 1-18) **New technology and higher environmental standards - challenges and solutions.** Reiten, E. (Norsk Hydro A/S (Norway)). Norsk Petroleumsforening, Oslo (Norway). 1991. 193p. (CONF-911143–: 5. international offshore Northern Seas advanced petroleum conference: exploration and development strategies in mature areas, Stavanger (Norway), 19-20 Nov 1991). In *Advanced Petroleum Conference 1991.* Order Number DE93752946. Source: OSTI; NTIS.

This lecture is concentrating on the environmental questions associated with the so-called greenhouse effect. In a short space of time, the potential threat from an increasing concentration of climatic gases in the atmosphere has achieved top priority among international environmental questions. The predominant part of the emissions of climatic gases from the petroleum sector is CO_2. In 1990, emissions of CO_2 from fields, pipelines and terminals on the Norwegian Continental Shelf were approaching 6 million tons, or ca 16% of the total Norwegian CO_2 emissions. In an effort to limit emissions from the offshore activities, the Norwegian authorities imposed a charge from the beginning of 1991 on CO_2 emissions equivalent to 60 oere per standard m^3 emission of gas to the atmosphere. This charge amounts to an increase in operating costs of about 10%. In addition to measures introduced by our authorities, the sector itself also has a responsibility to ensure that emissions are limited to what is absolutely necessary, within a reasonable economic and technological framework. Instead of committing to a specific percentage for the future potential reduction in unwanted emissions, the Petroleum Industry should rather state that every part of the Industry's organization from engineering, procurement and operations are committed to this task. The Petroleum Industry will continue to demonstrate a responsible approach also to this part of the environmental challenges. 5 figs.

5714 (NILU-OR–7/92) **Convention on long-range transboundary air pollution: UN/ECE international co-operative programme on effects on materials, including historic and cultural monuments.** Henriksen, J.F.; Bartonova, A.; Arnesen, K.; Rode, A. Norsk Inst. for Luftforskning, Lillestroem (Norway). Jan

1992. 145p. Order Number DE93753017. Source: OSTI; NTIS; INIS.

The United Nations Economic Commission for Europe (UN/ECE) International Co-operative Programme on Effects on Materials, including Historic and Cultural Monuments, has an extensive programme on material exposure in well defined environment. This report includes the environmental data from the third exposure year of temperature, relative humidity, time of wetness, sunshine hours, SO_2, NO_2 and O_3 concentrations and precipitation amount and quality. A statistical treatment of the data has been carried out. 7 refs., 13 figs., 11 tabs.

5715 (NILU-OR–20/92) **Report from a Nordic expert meeting on cost-effective international agreements on air pollution control.** Dovland, H. Norsk Inst. for Luftforskning, Lillestroem (Norway). Mar 1992. 131p. Order Number DE93753003. Source: OSTI; NTIS.

A Nordic meeting on cost-effective international agreements on air pollution control, after discussing papers presented on scientific and economic issues, concluded that for Europe a new sulfur protocol seems more appropriate than an acidification protocol. For the next NO_x protocol, however, efforts should be made to take into account both acidification, eutrophication and formation of photochemical oxidants. The meeting also stressed that if various economic instruments, e.g. emission trading, are to be further discussed, the concepts need further elaboration.

5716 (ORNL/M–1929/R3) **Environmental Regulatory Update Table, July–August 1992.** Houlberg, L.M.; Hawkins, G.T.; Lewis, E.B.; Salk, M.S. Oak Ridge National Lab., TN (United States). Sep 1992. 125p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93002620. Source: OSTI; NTIS; GPO Dep.

The Environmental Regulatory Update Table provides information on regulatory initiatives of interest to DOE operations and contractor staff with environmental management responsibilities. The table is updated bi-monthly with information from the Federal Register and other sources, including direct contact with regulatory agencies. Each table entry provides a chronological record of the rulemaking process for that initiative with an abstract and a projection of further action.

5717 (ORNL/M–1929/R4) **Environmental regulatory update table, September–October 1992.** Houlberg, L.M.; Hawkins, G.T.; Lewis, E.B.; Salk, M.S. Oak Ridge National Lab., TN (United States). Nov 1992. 124p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93003677. Source: OSTI; NTIS; GPO Dep.

The Environmental Regulatory Update Table provides information on regulatory initiatives of interest to DOE operations and contractor staff with environmental management responsibilities. The table is updated bi-monthly with information from the Federal Register and other sources, including direct contact with regulatory agencies. Each table entry provides a chronological record of the rulemaking process for that initiative with an abstract and a projection of further action.

5718 (SA-PUB–3/92) **The Finnish research programme on climate change: Progress report.** Kanninen, M.; Anttila, P. (eds.). Academy of Finland, Helsinki (Finland). 1992. 310p. Order Number DE93752870. Source: OSTI; NTIS.

SILMU Research Programme.

In 1989, the Ministry of Environment set up a committee to analyze our current knowledge on climatic changes and to define research needs related to the issue. The committee concluded its work by proposing that a large-scale multidisciplinary national research programme on climate change should be initiated. The committee defined the principal goals of the Finnish Research Programme on Climate Change (SILMU) as being to increase our knowledge on climate change, its causes, mechanisms and consequences; to strengthen the research on climate change in Finland; to increase the participation of Finnish researchers in international research programmes, and to prepare and disseminate information for policy makers on adaptation and mitigation. The key areas where research is to be directed are defined as: quantification of the greenhouse effect and the magnitude of anticipated climatic changes; assessment of the effects of changing climate on ecosystems, and development of mitigation and adaptation strategies. This volume comprises reports of the research projects included in SILMU. The aim of these reports is to describe the progress made in research during 1990-91, to illustrate the problem setting and lay out of the research work, and to present the results obtained. Due to the fact that most of the projects started in June 1990, only preliminary results can be presented at this stage. Future progress in SILMU will be reported periodically, with a final report being produced when the programme ends.

5719 (SNV–3980) **Evaluation of CFC-phaseout within the Swedish electronics industry.** Brox, B. (IVF-Swedish Institute for Production Engineering Research, Gothenburg (Sweden)); Tegehall, P.E.; Carlsson, P. Swedish Environmental Protection Agency, Solna (Sweden). 1992. 27p. Order Number DE93753040. Source: OSTI; NTIS.

Also available in Swedish as SNV–3976.

From Jan 1, 1991, CFC is banned as a cleaning agent within Swedish engineering industry. The use of CFC-113 was approx. 400 tons in 1986 and during 1991 almost nil. The electronic industry was the main user. In this report the result of an enquiry, sent to approx. 400 compnaies, is presented, and gives a detailed account of how the companies succeded in switching to CFC-free manufacturing processes.

5720 (SNV–3981) **CFC-phaseout in the Swedish polyurethane foam industry.** Swedish Environmental Protection Agency, Solna (Sweden). [1992]. 14p. Order Number DE93753041. Source: OSTI; NTIS.

Also available in Swedish as SNV–3978.

The effects of the ban issued by the Swedish Environmental Protection Agency on the use of selected CFCs in polyurethane foam processing in Sweden have been reviewed up to 1990. This report covering 57 polyurethane foam manufacturing plants or 90-95% of the total national capacity, summaries the present situation regarding already implemented technical options, problems still to be solved and costs involved as a consequence of the CFC phase out.

5721 (SNV–4006) **Evaluation of use of CFCs and HCFCs as refrigerants.** Jonsson, U. (AC Nielsen Company AB, Kista (Sweden)); Moeren, R. Swedish Environmental Protection Agency, Solna (Sweden). 1991. 41p. Order Number DE93753042. Source: OSTI; NTIS.

Also available in Swedish as SNV–3979.

The primary aim of this investigation is to elucidate how different groups have been influenced by regulations, concerning cooling agents, issued by the Swedish Environmental Protection Agency.

2904 Energy Resources

Refer also to citation(s) 4969, 5857, 6558

2905 Research, Development, Demonstration, and Commercialization

Refer also to citation(s) 5678, 5911, 5947

5722 (ANL/ES/CP–77747) **Determining effective technology transfer mechanisms: A case study in the Russian Federation.** Colangelo, R.V. (Environmental Planning Group, Inc., Elk Grove Village, IL (United States)); Reistroffer, E.; Edgar, D.E.; Johnson, D.O. Argonne National Lab., IL (United States). [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9210194–8: International symposium on environmental contamination, Budapest (Hungary), 12-16 Oct 1992). Order Number DE93003045. Source: OSTI; NTIS; GPO Dep.

In order to transfer technology efficiently, it is essential to define the cultural context in which the technologies have been developed and currently reside. As a participant in the International Technology Exchange Program (ITEP), the Environmental Planning Group, Inc. (EPG), had the opportunity to study environmental and energy programs in Russia. EPG found that the unstable political situation

in Russia, the inadequate funding in the Russian scientific community, and the withdrawal of government support for research have created new opportunities for accessing technology. EPG concluded that knowledge of the structure of the government and the organization of the scientific community and an understanding of current business practices are fundamental to the creation of successful technology transfer mechanisms.

5723 (CONF-9101154–, pp. 225-235) **EC promotional programmes in the range of energy.** Scholz, H.E. von. Bayerisches Staatsministerium fuer Wirtschaft und Verkehr, Muenchen (Germany). 1991. 306p. (In German). From Symposium on incentives for using renewable energy sources in Bavaria; Coburg (Germany); 28-29 Jan 1991. In *Incentives for using renewable energy sources in Bavaria. Symposium for users and suppliers (local authorities, public utilities, industry, medium enterprises).* Order Number DE93744689. Source: OSTI; NTIS (US Sales Only).

In the 80ties, energy consumption in the European Community has increased by c. 5% and its gross domestic product has risen by 21.6% by contrast. Although considerable energy conservations have been achieved, the Commission of the European Community continues its efforts to promote innovative energy technologies both to reduce the dependence from oil as energy carrier and to contribute more to pollution control. The author presents a number of selected programmes of DGXVII 'Energy': regional and municipal energy planning, SAVE and 'Thermie'. The 'Thermie' programme comprises the fields of rational energy utilization, renewable energy resources, solid fuels, and hydrocarbons. (BWI).

5724 (CONF-9101154–, pp. 236-242) **Promotional measures in Bavaria.** Gehrling, V. (Bayerisches Staatsministerium fuer Wirtschaft und Verkehr, Muenchen (Germany)). Bayerisches Staatsministerium fuer Wirtschaft und Verkehr, Muenchen (Germany). 1991. 306p. (In German). From Symposium on incentives for using renewable energy sources in Bavaria; Coburg (Germany); 28-29 Jan 1991. In *Incentives for using renewable energy sources in Bavaria. Symposium for users and suppliers (local authorities, public utilities, industry, medium enterprises).* Order Number DE93744689. Source: OSTI; NTIS (US Sales Only).

Although basic energy-policy decisions are to be taken by the Federal Government in Germany, the individual States, i.e. Laender, enjoy a certain scope of discretion and action, and may supplement by means of promotional programmes and information/consultancy of their own. To this end, Bavaria has conducted promotional measures for renewable energie, and energy economizing for some years. The author discusses major measures adopted for renewable energies. (BWI).

5725 (DOE/CE/15988–T1) **Inventors Center of Michigan Technical Assessment Program: Final progress report.** Ferris State Univ., Big Rapids, MI (United States). Technology Transfer Center. [1992]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90CE15988. Order Number DE93006067. Source: OSTI; NTIS; GPO Dep.

The Technical Assessment Program at the Inventors Center of Michigan is designed to provide independent inventors with a reliable assessment of the technical merits of their proposed inventions. Using faculty from within Ferris State University's College of Technology an assessment process examines the inventor's assumptions, documentation, and prototypes, as well as, reviewing patent search results and technical literature to provide the inventor with a written report on the technical aspects of the proposed invention. The forms for applying for a technical assessment of an invention are included.

5726 (DOE/CE–40956T-H1) **Federal agencies active in waste minimization and pollution prevention.** Research Management Consultants, Inc., Rockville, MD (United States). 31 Jul 1992. 122p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC01-91CE40956. Order Number DE93003688. Source: OSTI; NTIS; GPO Dep.

The National Energy Strategy calls for the United States to "reduce industrial energy waste generation, increase recycling of wastes, and increase use of plant- and consumer-generated wastes as process feedstocks". In response to this, the US Department of Energy (DOE) has created the Industrial Waste Reduction Program (IWRP) within the Office of Conservation and Renewable Energy, Office of Industrial Technologies (OIT). The primary objective of the IWRP is to increase industrial energy efficiency and productivity by reducing the generation of industrial wastes. Contained within the IWRP Program Plan are elements which include Technology Research & Development and Technology & Information Transfer. The purpose of this effort, Federal Agencies Active in Waste Minimization and Pollution Prevention, is to transfer technology and information, communicate with other Federal agencies involved in waste minimization/pollution prevention, help identify areas of mutual interest, and reduce redundant efforts. The Waste Material Management Division at OIT developed this inventory of Federal Research & Development waste minimization efforts. To maintain consistency between information gathered from Federal organizations, the term waste minimization/pollution prevention was used to label those efforts that reduce waste material or prevent pollution. Current trends and policies indicate that efforts will continue to grow within the Federal government in the area of waste minimization/pollution prevention. Accordingly, this document will need to be updated to reflect those changes.

5727 (DOE/ER–0184/8) **1993 application preparation URI Guide: University Research Instrumentation Program.** USDOE Office of Energy Research, Washington, DC (United States). Office of University and Science Education Programs. 5 Oct 1992. 49p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93002233. Source: OSTI; NTIS; GPO Dep.

The primary objective of the URI Program is to assist university and college scientists in strengthening their capabilities to conduct long-range experimental scientific research (both basic and applied) in specific energy areas of direct interest to DOE through the acquisition of specialized research instrumentation costing $100,000 or more.

5728 (DOE/ER–0535P/1) **DOE New Technology: Sharing new frontiers.** Tamura, A.; Kane, L. (eds.). USDOE Office of Scientific and Technical Information, Oak Ridge, TN (United States). Nov 1992. 107p. Sponsored by USDOE, Washington, DC (United States). Order Number DE92041170. Source: OSTI; NTIS; GPO Dep.

The purpose of this publication is to provide information on how to access specific technologies developed through research sponsored by DOE and performed by DOE laboratories or by contracted researchers. This document describes technologies identified as having potential for commercial applications, in addition to a catalog of current patent applications and patents available for licensing for DOE and DOE contractors.

5729 (ETDE-mf–93742653) **Promotion of basic research through the Federal Minister for Research and Technology. Recommendations of the Commission for Basic Research.** BMFT - Pressedokumentation. Bundesministerium fuer Forschung und Technologie, Bonn (Germany). 3 Apr 1992 124p. (In German). Order Number DE93742653. Source: OSTI; NTIS (US Sales Only).

In July 1990 the Federal Minister for Research and Technology appointed an advisory commission to the task of discussing the possibilities and chances of improving, changing and complementing the promotion of basic research through his ministry. This is the first commission to have been assigned to dealing with the entire spectrum of tasks in basic research of the Federal Ministry for Research and Technology rather than to a specific question (e.g. the priority and necessity of large-scale equipment). The make-up of the commission was correspondingly multidisciplinary. There was a dramatic change in the fininancial outlook during the consultation year. The comission has divided its discussions into four subareas. These are: Areas that are important, new or deserve expansion, - clinical research; - large scale equipment for research purposes; - structural questions of research promotion. The report of the commission is structured analogously. It begins with an analysis of the spectrum of basic reseach currently being sponsored. The four main sections named above are rounded off with recommendations for the European perspective and an analysis of the cooperation between science, the industry and the state in the area of basic research. (orig./HSCH).

5730 (LBL-PUB–5334) **Lawrence Berkeley Laboratory institutional Plan, FY 1993–1998.** Lawrence Berkeley Lab., CA (United States). Oct 1992. 151p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE93002600. Source: OSTI; NTIS; GPO Dep.

The FY 1993–1998 Institutional Plan provides an overview of the Lawrence Berkeley Laboratory mission, strategic plan, scientific initiatives, research programs, environment and safety program plans, educational and technology transfer efforts, human resources, and facilities needs. The Strategic Plan section identifies long-range conditions that can influence the Laboratory, potential research trends, and several management implications. The Initiatives section identifies potential new research programs that represent major long-term opportunities for the Laboratory and the resources required for their implementation. The Scientific and Technical Programs section summarizes current programs and potential changes in research program activity. The Environment, Safety, and Health section describes the management systems and programs underway at the Laboratory to protect the environment, the public, and the employees. The Technology Transfer and Education programs section describes current and planned programs to enhance the nation's scientific literacy and human infrastructure and to improve economic competitiveness. The Human Resources section identifies LBL staff composition and development programs. The section on Site and Facilities discusses resources required to sustain and improve the physical plant and its equipment. The Resource Projections are estimates of required budgetary authority for the Laboratory's ongoing research programs. The plan is an institutional management report for integration with the Department of Energy's strategic planning activities that is developed through an annual planning process. The plan identifies technical and administrative directions in the context of the National Energy Strategy and the Department of Energy's program planning initiatives. Preparation of the plan is coordinated by the Office for Planning and Development from information contributed by the Laboratory's scientific and support divisions.

5731 (NEI-DK–1023) **Polar research: Strategy and plan of action 1993-1997.** Kommissionen for Videnskabelige Undersoegelser i Groenland, Copenhagen (Denmark). 1992. 43p. (In Danish). Order Number DE93752797. Source: OSTI; NTIS.

It is stated that Denmark has a long tradition of polar research as a result of its relations with Greenland, and has both national and international commitments in this field. The strategy and action plan of the Commission for Scientific Research in Greenland for 1993-97 is a review of the significance and potential of polar research for Danish and Greenlandic society which will form a basis for the provision of new resources for a dynamic, coordinated research effort. The aim is to maintain and develop Danish/Greenlandic polar research at the international level as a field where Danish research is able to make its mark internationally, and which considers the special needs of the Danish and Greenlandic societies. In 1993-1997 the Commission will give particularly high priority to research activities in the areas of global environment, Arctic natural resources and Arctic social development. Besides coordinating with the strategy plans of the research councils, the Commission has attached great importance to ensuring that international standards are reached, that research coordinates with international research programmes and that research can help to strengthen the development of Greenlandic society. The Commission will substantially increase subsidies to forward this cause. The plan of action includes every aspect of possible support to the successful propogation of this overall research programme. (AB).

5732 (NEI-SE–97) **Svensk Energiutveckling. Annual report 1991.** Svensk Energi Utveckling AB, Stockholm (Sweden). [1992]. 23p. (In Swedish). Order Number DE93753068. Source: OSTI; NTIS.

Swedish utilities and distributers founded SEU in 1988 for promoting RDD on new and environmentally safe electric power production and efficient electricity use. The activity in SEU is supported last for one decade. 111 projects have been started at a total cost of 2 BSEK (about 350 MUSD). A brief review of the project areas and an economic account for 1991 is given in the report.

5733 (RISO-R–604) **Meteorology and Wind Energy department. Annual progress report 1 January - 31 December 1991.** Petersen, E.L.; Skrumsager, B. (eds.). Risoe National Lab., Roskilde (Denmark). Meteorology and Wind Energy. Aug 1992. 39p. Order Number DE93752744. Source: OSTI; NTIS.

The primary objective of the department is to make an essential contribution to research, development, and consulting in connection with the production, application and export of Danish wind turbines. A secondary objective is to carry out research in boundary-layer meteorology, which is fundamental to solving major environmental and energy problems of society. There is a general demand for an improved ability to describe and estimate flows and fluxes in the lower part of the atmosphere with regard to wind resources, a multitude of environmental questions, and loads on structures including wind turbines. Through its research and development work, the department is able to develop methodologies including computer models for use by industry, institutions, and governmental authorities. In the long view the department is developing facilities and programmes to enable it to serve as a national and European centre for wind energy and boundary-layer meteorological research. (au).

5734 (SAND–92-0369) **Sandia Technology engineering and science accomplishments: Volume 15, No. 1.** Van Arsdall, A.; Floyd, H.L.; Goetsch, B.; Parrott, L.; Pruett, H. (eds.). Sandia National Labs., Albuquerque, NM (United States). 1992. 78p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93005042. Source: OSTI; NTIS; INIS; GPO Dep.

This document presents recent accomplishments in engineering and science at Sandia National Laboratories. Commercial-scale parabolic troughs at the National Solar Thermal Test Facility are used for such applications as heating water, producing steam for industrial processes, and driving absorption air conditioning systems. Computerized-aided design, superconductor technology, radar imaging, soldering technology, software development breakthroughs are made known. Defense programs are exhibited. And microchip engineering applications in test chips, flow sensors, miniature computers, integrated circuits, and microsensors are presented.

2906 Nuclear Energy

Refer also to citation(s) 5435, 5437, 5438, 5746

5735 (DOE/S–0099P) **National Energy Strategy: Technical annex 7: Nuclear power and the National Energy Strategy: First edition 1991/1992.** USDOE, Washington, DC (United States). [1992]. 42p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93002234. Source: OSTI; NTIS; INIS; GPO Dep.

This paper provides analyses of nuclear energy options and the role of nuclear power as a future energy source for the United States. The Current Policy Base case reflects an energy future with no new nuclear policy initiatives and the gradual phaseout of nuclear power. This paper compares such a phaseout to the expanded use of nuclear power and identifies the consequences.

2910 Conservation

Refer also to citation(s) 5741, 5776

5736 (PNL-SA–21185) **Lighting technology specifications for relighting federal buildings.** Harris, L. (USDOE, Washington, DC (United States)); Purcell, C.; Gordon, H.; McKay, H. Pacific Northwest Lab., Richland, WA (United States). Oct 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-921021–3: 15. world energy engineering congress (WEEC), Atlanta, GA (United States), 13-15 Oct 1992). Order Number DE93004333. Source: OSTI; NTIS; GPO Dep.

Under a Federal Relighting Initiative (FRI) project, a set of Master Lighting Technology Specifications was developed for use by the Federal sector in relighting buildings. The specifications were to cover all major lighting technologies. The initial set was developed and issued for extensive peer review in December 1991. Extensive

comments were received from industry, Federal sector participants (DOD, GSA, NASA, DOE, etc.), national laboratories, professional lighting organizations, private lighting professionals, and recognized experts in the lighting community. The document underwent extensive revision and was reissued in June 1992 for a second round of peer review. The current FRI Lighting Technology Specifications are organized into two sections: (1) Technical Notes and (2) Master Specifications. The Technical Notes contain explanations that enable the users to understand the background and reasons for specification requirements. The Master Specifications are organized in the Construction Specifications Institute (CSI) format and are intended to form the basis for competitive bidding and contracting to undertake relighting initiatives.

2920 Supply, Demand, and Forecasting

Refer also to citation(s) 5739, 5752, 5753, 5754, 5776

5737 (IEE-IC–92) **Estimated long-term energy demand and supply in major European countries and problems in their policies.: Report of survey in Europe.** Institute of Energy Economics, Tokyo (Japan). 1 Jul 1992. 53p. (In Japanese). Order Number DE93754080. Source: OSTI; NTIS.

The Japan Energy Research Institute made an on-site survey on a long-term prospect in energy demand and supply in major European countries after attending the annual IAEE conference in May 1992. The objectives of the survey were: Long-term prospect on energy demand and supply, energy policies and energy saving measures in relation with environmental problems, methodologies of long-term estimation on the demand and supply and their problems, and energy policies after the EC market integration, and their effects. This paper describes a summary of the survey. The countries visited for the survey include France, Germany, England, Belgium and others. The above items included in the survey are promoted by each country assuming scenarios for every five years starting 2000. Coordinately and positively working with the EC committee are France and England. Such an outline may be presented that actions taken by the countries are not in harmony because of differences in states of general and political affairs in each country, and the policy implementation is still premature requiring more time before the policies can be fully executed. The relation of economic growth rate and energy demand and supply as well as enerronmental problems and their progress will be the main objects to be studied. 12 figs., 6 tabs.

5738 (NUTEK-B–92-9) **Energy report 1992.** Bjoerk, O.; Carlen, B.; Eng, T.; Hillring, B.; Kornerud, S.; Lewald, A.; Lublin, Z.G.; Montin, S.; Ohlsson, H.; Swartling, K.; Wikstroem, A. Swedish National Board for Industrial and Technical Development (NUTEK), Stockholm (Sweden). Sep 1992. 204p. (In Swedish). Order Number DE93753071. Source: OSTI; NTIS.

In this report to the Swedish government, the Board for Industrial and Technical Development presents a review of the Swedish energy system and an evaluation of how the governmental support for environmentally acceptable power generation and more efficient energy use have been employed. Electric power production and consumption is analyzed, and a prognosis of their development for the next ten years is given. Use of fossil fuels, peat and biofuels for heat and power production and in industry is presented. (27 figs., 95 tabs.).

2930 Policy, Legislation, and Regulation

Refer also to citation(s) 5140, 5436, 5439, 5440, 5684, 5697, 5699, 5709, 5737

5739 (INIS-XN–419) **Energy policy of the International Energy Agency (IEA) countries. General review of the year 1990.** Nuclear Energy Agency, 75 - Paris (France). 1992. [527] (In French). Order Number DE93609587. Source: OSTI; NTIS (US Sales Only); INIS.

This book is a general review on energy policy leaded by Members countries of International Energy Agency (IEA) during the year 1990. This book describes also the trends and the recent events which have affected energy demand, energy conservation, energy efficiency, energy supply and energy source development. This annual review gives the IEA energy forecasting for the next years, till year 2001. A detailed study of energy policy in Federal Republic of Germany, Austria, Denmark, Greece, Ireland and Japan is given. The policy of fifteen another Members countries, which have been analyzed the previous years, is recapitulated and briefly brought up to date.

5740 (NEI-DK–1027) **Energy 2000: Seen in relation to the future.** Beck, C.; Bjerre, A.; Jensen, S.; Olsen, S.; Palludan, U. Instituttet for Fremtidsforskning, Copenhagen (Denmark). Jun 1991. 54p. (In Danish). Order Number DE93752975. Source: OSTI; NTIS.

This paper discusses the concept of energy in the year 2000 in terms of energy in relation to the future.

5741 (RISO-M–2941) **Energy conservation potentials in Lithuania and Latvia.** Fenhann, J. (ed.). Risoe National Lab., Roskilde (Denmark). Systems Analysis. Aug 1992. 67p. Order Number DE93752750. Source: OSTI; NTIS.

This is the third report in a series of reports about the energy systems in the Baltic countries: Estonia, Latvia and Lithuania from the project "Baltic-Nordic cooperation in the field of energy and environment" financed by the Energy Market Group under the Nordic Council of Ministers. The present report tries to illustrate the potentials for energy conservation in Lithuania and Latvia. For Lithuania the material is based on the "National energy efficiency programme", which was prepared in 1991. It documents that the energy conservation potentials are large, especially in the heating sector. It includes the views of the Lithuantan specialists of the best measures and strategic directions to restructure the energy system. For Latvia similar material is not available but will be developed in the tasks described in the National Energy Saving Strategy which the Government has established. This strategy is described and thoughts about future developments had to be based on energy projections from 1990 which although they are rather high still reflects some of the future possibilities including a calculation of the energy saving potentials also made in 1990. The section about Latvia also contain chapters of the wood, straw and peat resources. (au) (19 tabs., 18 ills.).

2940 Fossil Fuels

Refer also to citation(s) 4967, 4992, 4997, 5000, 5002, 5007, 5745, 5746

5742 (NEI-NO–299) **Norwegian Petroleum Directorate: Annual report 1991.** Oljedirektoratet, Stavanger (Norway). 1992 150p. (In Norwegian). Order Number DE93752968. Source: OSTI; NTIS.

The annual report of the Norwegian Petroleum Directorate deals with the exploration and development of oil and gas fields on continental shelf. Topics being covered are as follow: The activity on the Norwegian continental shelf; petroleum resources; safety and working environment in the offshore activity; petroleum economics; special elucidations and projects; international cooperation; general views and statistics. 40 figs., 21 tabs.

2960 Electric Power

Refer also to citation(s) 5352, 5379, 7419

5743 (BFR-D–8-92) **Studies in the economics of electricity and heating.** Andersson, Roland (Stockholm Univ. (Sweden). Dept. of Economics); Bohman, M.; Taylor, L. Swedish Council for Building Research, Stockholm (Sweden). 1992. 223p. Order Number DE93753058. Source: OSTI; NTIS; INIS.

This study deals with problems of pricing and capacity planning of electricity and to some extent, heat, as well as with the evalution of research and development projects. A critical review is given of the discussion in the economic literature concerning whether the price for public utilities should be based on short-run (SRMC) or long-run marginal costs (LRMC). We find it advisable to dispense with the LRMC concept altogether and rely on pricing based on SRMC. We deal with the design of such prices, how they depend on peak and off-peak loads, locational differences in production, transmission and distribution costs etc., particularly when both demand and supply are random. Then follows a critical analysis of

the high-voltage as well as low-voltage electricity tariffs used in Sweden. The coordinated pricing system used among power producers in the Nordic countries is found to be an almost ideal application of the theory. The problem of deriving an optimal price structure for cogenerated electricity and heat used for district heating in local communities is analyzed together with an attempt to measure short-run welfare gains of switching from the existing price structure in a stylized local community to the optimal price structure. A critical review presents concepts and methods used to assess the social costs of unsupplied electricity. Methods for dimensioning production capacity for electricity energy in an efficient way, and the problems of dimensioning production capacity for electricity in a socially optimal way are discussed. We then go on to examine the investment criteria used by the Swedish power industry. We also analyze criteria for appraisal of energy R and D projects from a governments perspective and present a model based on sequential decision making for evaluating uncertain energy R and D projects. (au) (138 refs., 45 figs. 18 tabs.).

5744 (CONF-920828–22) **Coming to terms with DSM.** Sabo, C.A. (Barakat and Chamberlin, Inc., Washington, DC (United States)); Hirst, E. Oak Ridge National Lab., TN (United States); Tennessee Valley Authority, Muscle Shoals, AL (United States). Aquatic Biology Dept. [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From American Council for an Energy-Efficient Economy (ACEEE) summer study on energy efficiency in buildings; Pacific Grove, CA (United States); 30 Aug - 5 sep 1992. Order Number DE93003092. Source: OSTI; NTIS; GPO Dep.

The number, magnitude, and importance of DSM programs are growing rapidly. With the increase in DSM activity throughout the United States, there has been a comparable increase in the need for information on the results of utilities' DSM programs. Information requests come from a variety of sources using a variety of sources using a variety of definitions and reporting formats. Utilities are frustrated by the amount of time required to respond to the myriad of requests for program data. Utilities are even more frustrated by an inability to draw useful conclusions from the data to gauge DSM program performance and to predict market response.

5745 (DOE/EIA–0226(92/10)) **Electric power monthly, October 1992.** USDOE Energy Information Administration, Washington, DC (United States). Office of Coal, Nuclear, Electric and Alternate Fuels. 16 Oct 1992. 207p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93002634. Source: OSTI; NTIS; GPO; GPO Dep.

The Electric Power Monthly (EPM) presents monthly summaries of electric utility statistics at the national, Census division, and State level. The purpose of this publication is to provide energy decisionmakers with accurate and timely information that may be used in forming various perspectives on electric issues that lie ahead. The EPM is prepared by the Survey Management Division; Office of Coal, Nuclear, Electric and Alternate Fuels, Energy Information Administration (EIA), Department of Energy. This publication provides monthly statistics at the national, Census division, and State levels for net generation, fuel consumption, fuel stocks, quantity and quality of fuel, cost of fuel, electricity sales, revenue, and average revenue per kilowatthour of electricity sold. Data on net generation, fuel consumption, fuel stocks, quantity and cost of fuel are also displayed for the North American Electric Reliability Council (NERC) regions. Additionally, statistics by company and plant are published in the EPM on capability of new plants, net generation, fuel consumption, fuel stocks, quantity and quality of fuel, and cost of fuel.

5746 (DOE/EIA–0226(92/11)) **Electric power monthly, November 1992.** USDOE Energy Information Administration, Washington, DC (United States). Office of Coal, Nuclear, Electric and Alternate Fuels. 19 Nov 1992. 206p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93003713. Source: OSTI; NTIS; GPO; GPO Dep.

The EPM is prepared by the Survey Management Division; Office of Coal, Nuclear, Electric and Alternate Fuels, Energy Information Administration (EIA), Department of Energy. This publication provides monthly statistics at the national, Census division, and State levels for net generation, fuel consumption, fuel stocks, quantity and quality of fuel, cost of fuel, electricity sales, revenue, and average revenue per kilowatt-hour of electricity sold. Data on net generation, fuel consumption, fuel stocks, quantity and cost of fuel are also displayed for the North American Electric Reliability Council (NERC) regions. Additionally, statistics by company and plant are published in the EPM on capability of new plants, net generation, fuel consumption, fuel stocks, quantity and quality of fuel, and cost of fuel.

5747 (ETDE-mf–93744514) **Priority for private persons in public electric power supply.** Stern, V. Bund der Steuerzahler e.V., Wiesbaden (Germany). Karl-Braeuer-Institut. Feb 1992 87p. (In German). Order Number DE93744514. Source: OSTI; NTIS (US Sales Only).

In the list of vitally necessary goods, electric power is at the top without any doubt. Has electric power supply therefore be taken by the public ownership? Somebody, who has a look on the conditions in Germany might gain this impression. The old Federal states and their communities are considerably involved in the public electric power supply as holders or share holders. In the new states, the structures are also in this field in a radical change. On the local level tendencies are intensified to transfer the electric power supply to own urban power stations. The discussion about this provides the impression that ideologic points of view play a bigger role than factual arguments. This study want to contribute to objectification. An investigation is made, whether the experiences in the old states speak for or against the fact that the public ownership - and thus the communities - is involved in the public energy supply also in the new states. (orig.).

5748 (TKK-S/SM–1989/21) **Symposium on electrical power engineering.** Jokinen, T. (ed.). Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Electromechanics. 1989. 130p. (CONF-8901144–: Symposium on electrical power engineering at the Helsinki University of Technology, Espoo (Finland), 27 Jan 1989). Order Number DE93711132. Source: OSTI; NTIS.

The Helsinki University of Technology Symposium on Electrical Power Engineering was held in Espoo, Finland, on January 27, 1989. The Symposium was organized by Faculty of Electrical Engineering, Laboratory of Electromechanics. The programme consisted of detailed technical sessions on Power Distribution Systems, Thermal Power Plants, Optimization of Power Systems, Turbogenerators, Water Pumps, Steady-State Control, Power Transmission Systems, Induction Motors, Synchronous Machines, MHD Drive, Servomechanism of Robots and Knowledge-Based Power Systems.

5749 (TKK-S/SM–1989/21, pp. 13-20) **On optimal active and reactive load planning of thermal power plants considering probabilistic information.** Leisalu, A. (Tallinn Technical Univ. (Estonia). Power Systems Cybernetics Lab.). Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Electromechanics. 1989. (CONF-8901144–: Symposium on electrical power engineering at the Helsinki University of Technology, Espoo (Finland), 27 Jan 1989). In *Symposium on electrical power engineering.* 130p. Order Number DE93711132. Source: OSTI; NTIS.

A universal relatively simple method for calculating the optimal state of complicated thermal power plants is presented here. Problems concerning optimal planning of electric and thermal loads are discussed. Probabilistic qualities of initial data are considered using the method of planned characteristics. Corresponding computer programs are discussed.

5750 (TKK-S/SM–1989/21, pp. 123-130) **Reactive power and voltage control - A knowledge-based approach.** Wilhelmsson, K. (The Royal Institute of Technology, Stockholm (Sweden). Electric Power Systems). Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Electromechanics. 1989. (CONF-8901144–: Symposium on electrical power engineering at the Helsinki University of Technology, Espoo (Finland), 27 Jan 1989). In *Symposium on electrical power engineering.* 130p. Order Number DE93711132. Source: OSTI; NTIS.

This paper presents a new method for control of voltage and reactive power in an electric power system. To handle a voltage and/or reactive power violation empirical rules are used to generate appropriate control actions. Controllers such as generator excitation, capacitors and transformers tap changer are utilized. With this

guidance method, the operator can obtain a desirable operating point. A knowledge based approach with frame based representation of knowledge and production rules is proposed to perform the above functions.

2990 Unconventional Sources and Power Generation

Refer also to citation(s) 5288, 5773

5751 (CONF-9101154–) **Incentives for using renewable energy sources in Bavaria. Symposium for users and suppliers (local authorities, public utilities, industry, medium enterprises).** Reihe Tagungsberichte des Staatsministeriums fuer Wirtschaft und Verkehr. Bayerisches Staatsministerium fuer Wirtschaft und Verkehr, Muenchen (Germany). 1991 306p. (In German). From Symposium on incentives for using renewable energy sources in Bavaria; Coburg (Germany); 28-29 Jan 1991. Order Number DE93744689. Source: OSTI; NTIS (US Sales Only).

Every paper presented to the symposium and in this proceedings volume has been indexed and analysed for individual retrieval from the database. The symposium was intended as a platform for showing the state of the art in research and technology for the use of all kind of renewable energy sources, from photovoltaic energy systems or hydrodynamic power up to power derived from biomass. The systems discussed also include demonstration plant and pilot projects. The survey of activities pursued in Bavaria by various institutions, such as the Land Government, local authorities, public utilities and industry, shows the progress achieved in the Federal State of Bavaria towards an enhanced use of renewable energy sources. The symposium brought together users and suppliers in their field for discussion, exchange of information and cooperation. (orig./HP).

5752 (CONF-9101154–, pp. 17-32) **The potential of rational energy utilization and renewable energies in Bavaria.** Schaefer, H. (Forschungsstelle fuer Energiewirtschaft, Muenchen (Germany)); Geiger, B.; Kuhn, H. Bayerisches Staatsministerium fuer Wirtschaft und Verkehr, Muenchen (Germany). 1991. 306p. (In German). From Symposium on incentives for using renewable energy sources in Bavaria; Coburg (Germany); 28-29 Jan 1991. In *Incentives for using renewable energy sources in Bavaria. Symposium for users and suppliers (local authorities, public utilities, industry, medium enterprises).* Order Number DE93744689. Source: OSTI; NTIS (US Sales Only).

Technological and nontechnological measures of energy saving can be grouped under the terms of 'energy conservation', 'national energy utilization', and 'substitution of energy carriers'. Economizing of energy can be flanked by the development of renewable energies to space our resources. The author estimates the potential of individual energy carriers to be used by the year 2010 for their respective supply, profitability and market penetration strength. Wind, geothermal and photovoltaic energies are expected not to have a major potential in the long term. Solar thermal and heat pump systems are expected to break through once fuel prices will soar which applies especially to the fields of hot water preparation, space heating and indoor-swimming-pool water heating. (BWI).

5753 (CONF-9101154–, pp. 139-150) **Photovoltaics, wind power and landfill gas applications in Upper Bavaria.** Stadtmueller, H. (Isar-Amperwerke AG, Muenchen (Germany)). Bayerisches Staatsministerium fuer Wirtschaft und Verkehr, Muenchen (Germany). 1991. 306p. (In German). From Symposium on incentives for using renewable energy sources in Bavaria; Coburg (Germany); 28-29 Jan 1991. In *Incentives for using renewable energy sources in Bavaria. Symposium for users and suppliers (local authorities, public utilities, industry, medium enterprises).* Order Number DE93744689. Source: OSTI; NTIS (US Sales Only).

The author presents a number of projects for the utilization of renewable energies in Bavaria. These comprise: photovoltaic systems for grid- independent power supply of a farm, landfill gas utilization in upper Bavaria, and a study on the wind potential in the Prealps region. Implemention of these projects will certainly contribute to the long-term competitiveness of these technologies, through their contribution to energy generation may be expected to be low in the foreseeable future. (BWI).

5754 (CONF-9101154–, pp. 168-178) **Landfill gas, photovoltaics and solar mobile technology applications in Frankonia.** Dicke, W. (Fraenkisches Ueberlandwerk AG, Nuernberg (Germany)). Bayerisches Staatsministerium fuer Wirtschaft und Verkehr, Muenchen (Germany). 1991. 306p. (In German). From Symposium on incentives for using renewable energy sources in Bavaria; Coburg (Germany); 28-29 Jan 1991. In *Incentives for using renewable energy sources in Bavaria. Symposium for users and suppliers (local authorities, public utilities, industry, medium enterprises).* Order Number DE93744689. Source: OSTI; NTIS (US Sales Only).

A number of projects are being implemented for the use of renewable energy sources in the Bavarian province of Frankonia. The author presents particularly interesting projects: landfill gas utilization for which 3 landfill-gas-fired power plants have been built already; photovoltaics with special investigation into its use for solar mobiles; wind power plants and the construction of a model energy-economizing building. (BWI).

5755 (CONF-9101154–, pp. 179-190) **Hydroelectricity, gas heat pumps and geothermal project at Straubing/Lower Bavaria.** Jaehn, W. (Stadtwerke Straubing (Germany)). Bayerisches Staatsministerium fuer Wirtschaft und Verkehr, Muenchen (Germany). 1991. 306p. (In German). From Symposium on incentives for using renewable energy sources in Bavaria; Coburg (Germany); 28-29 Jan 1991. In *Incentives for using renewable energy sources in Bavaria. Symposium for users and suppliers (local authorities, public utilities, industry, medium enterprises).* Order Number DE93744689. Source: OSTI; NTIS (US Sales Only).

The town of Straubing in Bavaria promotes a number of projects to use renewable energy sources which are presented by the author: hydroelectricity, gas heat pumps and dual-purpose power stations, and a geothermal project. Diagrams and graphs are used to show the energy gains/profitabilities of these plant types. (BWI).

5756 (CONF-9205279–, pp. 15-24) **External costs and the use of renewable energies.** Zuchtriegel, T. (Bundesminiserium fuer Wirtschaft, Bonn (Germany)). Ostbayerisches Technologie-Transfer-Institut e.V. (OTTI), Regensburg (Germany). 1992. 304p. (In German). From 2. national symposium on thermal solar energy (TSE); Staffelstein (Germany); 14-15 May 1992. In *Second national symposium 'Thermal solar energy'.* Order Number DE93744460. Source: OSTI; NTIS (US Sales Only).

Economic theory speakes of external effects if the use and production factors of an individual are influenced by real factors, the values of which (positive or negative) are influenced by other factors. Their quantification, monetarization and internalization are objects of intensive study within the public debate on energy. The author studies external costs for the relevance for renewable energies. The findings indicate that the internalization of external costs of energy generation and utilization will improve the market opportunities of renewable energies including thermal solar energy. (BWI).

5757 (CONF-9205279–, pp. 25-51) **The utilization potential of solar energy.** Nitsch, J. (Studiengruppe Energiesysteme, DLR, Stuttgart (Germany)); Nast, M. Ostbayerisches Technologie-Transfer-Institut e.V. (OTTI), Regensburg (Germany). 1992. 304p. (In German). From 2. national symposium on thermal solar energy (TSE); Staffelstein (Germany); 14-15 May 1992. In *Second national symposium 'Thermal solar energy'.* Order Number DE93744460. Source: OSTI; NTIS (US Sales Only).

Solar energy can be used both by passive and by active methods. Active systems, i.e. collector systems, can be clearly defined for their system configurations, energy yields and costs. Passive applications, by contrast, are diverse and often interact with each other, and cannot be rated by themselves unless they are evaluated together with measures adopted for rational energy utilization in buildings. This also means that individual measures often fail to be assigned a proper position within energy and economy evaluations. The author assesses the potential of both active and passive applications of thermal solar energy. (BWI).

5758 (NEI-DK–1020) **The socio-economic costs of the planned development of wind power energy.** Skriftserie K. Nationaloekonomisk Institut, 22. Bentzen, J. Handelshoejskolen i Aarhus (Denmark). Nationaloekonomisk Inst. Sep 1992. 28p. (In Danish). Order Number DE93752794. Source: OSTI; NTIS; INIS.

The socio-economic consequences of the Danish government's planned further development of wind power energy are discussed in detail. It is claimed that, currently, electricity produced by wind turbines is more expensive than that produced by power stations, if the relative environmental effects are not taken into consideration. It is expected that technological development will contribute to cost reduction by the year 2010 so that electricity produced by wind turbines will be competitive, but until then costs of wind power energy will be high and it is reckoned that losses will be in the range of 5-6 billion Danish crowns, minus 2.5 billion saved by lack of CO_2 emission. The socio-economic factors regarding windmills of various sizes (150 kW and 225 kW) are calculated and the planned development of wind power until 2010 is explained. The socio-economic costs of the development programme under various conditions, including the calculation of the saved emissions of carbon dioxide, are discussed. The author states that, in the light of these arguments, he is not in agreement with the governmental plan for the development of wind-turbine produced electricity. It is suggested that this plan could be postponed until such time as wind-power produced electricity should be more competitive in price, and that it should not be pursued during a period of economic recession. (AB).

30 DIRECT ENERGY CONVERSION

3001 MHD Generators

Refer also to citation(s) 5985

5759 (ANL/CP–75323) **Simulation of a particle-laden combustion flow in an MHD second stage combustor.** Chang, S.L.; Lottes, S.A. Argonne National Lab., IL (United States). [1992]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-921110–41: Winter annual meeting of the American Society of Mechanical Engineers (ASME), Anaheim, CA (United States), 8-13 Nov 1992). Order Number DE93004244. Source: OSTI; NTIS; GPO Dep.

An Argonne two-phase combustion flow computer code is used to simulate reacting flows to aid the development of an advanced combustor for magnetohydrodynamic power generation. The combustion code is a general hydrodynamics computer code for two-phase two-dimensional, steady state, turbulent, and reacting flows, based on mass, momentum, and energy conservation laws for multiple gas species. The combustion code includes turbulence, integral combustion, and particle evaporation submodels. The newly developed integral combustion submodel makes calculations more efficient and more stable while still preserving major physical effects of the complex combustion processes. The combustor under investigation is a magnetohydrodynamic second stage combustor in which opposed jets of oxidizer are injected into a confined cross-stream of hot coal gas flow following a first stage swirl combustor. The simulation is intended to enhance the understanding of seed particle evolution in the combustor and evaluate the effects of combustor operation conditions on seed particle evolution and vapor dispersion, which directly affect overall magnetohydrodynamic power generation. Simulation results show that oxidizer jet angle and particle size have great effect on the particle evolution and vapor dispersion. At a jet angle about 130 degrees, particle evaporation rate is the highest because of the highest average gas temperature. For particles having a smaller mean diameter, particle evaporation is more complete and vapor dispersion is more uniform.

5760 (DOE/ET/10815–201) **Application of proof-of-concept test data to design of commercial MHD steam bottoming plants.** Johanson, N.R.; Attig, R.C.; Muehlhauser, J.W.; Chapman, J.N.; Sanders, M. Tennessee Univ., Tullahoma, TN (United States). Space Inst. [1992]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-79ET10815. (CONF-921110–31: Winter annual meeting of the American Society of Mechanical Engineers (ASME), Anaheim, CA (United States), 8-13 Nov 1992). Order Number DE93002657. Source: OSTI; NTIS; GPO Dep.

The University of Tennessee Space Institute (UTSI) personnel recently completed the 2000-hour proof-of-concept test program while firing Illinois No. 6 coal. Ash deposition was different from that in conventional boilers due to the high concentrations of potassium compounds and smaller ash particles. The deposition rate was rapid and higher temperature deposits were hard and difficult to remove, but we believe that control techniques, high pressure air sootblowers, will be effective. Corrosion results are not yet complete for specimens exposed for 1500 and 2000 hours, but examination after 500 hours and results available after 1500 and 2000 hours suggested that conventional superheater alloys will be satisfactory at normal exposure temperatures and Type 310, a 25% chrome stainless steel will be satisfactory for higher temperatures expected for intermediate temperature airheaters. Environmental monitoring stations indicated no significant impact on the area around the Coal Fired Flow Facility (CFFF). These results and others are summarized in the paper.

5761 (DOE/ET/15601–43) **Diagnostic development and support of MHD test facilities: Technical progress report, October, November, December 1990.** Mississippi State Univ., MS (United States). Diagnostic Instrumentation and Analysis Lab. [1990]. 82p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-80ET15601. Order Number DE93005919. Source: OSTI; NTIS; GPO Dep.

The Diagnostic Instrumentation and Analysis Laboratory (DIAL) at Mississippi State University (MSU) is developing diagnostic instruments for MHD power train data acquisition and for support of MHD component development test facilities. Microprocessor-controlled optical instruments, initially developed for Heat Recovery/Seed Recovery support, are being refined, and new systems to measure temperatures and gas-seed-slag stream characteristics are being developed. To further data acquisition and analysis capabilities, the diagnostic systems are being interfaced with DIAL's computers. Technical support for the diagnostic needs of the national MHD research effort is being provided. DIAL personnel will also cooperate with government agencies and private industries to improve the transformation of research and development results into processes, products, and services applicable to their needs.

5762 (DOE/PC/79672–T4) **MHD seed recovery/regeneration, Phase 2: Technical progress report quarter ending, August 28, 1992.** TRW, Inc., Redondo Beach, CA (United States). Applied Technology Div. [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-87PC79672. Order Number DE93006008. Source: OSTI; NTIS; GPO Dep.

Three tasks are reported on: design, refurbish, operate potassium formate system; design, construct, operate the calcium formate production POC; and Western seed studies (spent Western seed is a mixture of potassium carbonate and potassium sulfate plus inerts).

5763 (TKK-S/SM–1989/21, pp. 101-106) **Technical monitoring system of MHD drive.** Jansikene, R. (Tallinn Technical Univ. (Estonia). Dept of Power Systems). Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Electromechanics. 1989. (CONF-8901144–: Symposium on electrical power engineering at the Helsinki University of Technology, Espoo (Finland), 27 Jan 1989). In *Symposium on electrical power engineering.* 130p. Order Number DE93711132. Source: OSTI; NTIS.

The present paper is conserned with the possibilities for application of technical diagostics in MHD drive control system. The general structure of diagostic system in case of MHD drive with two-motor microprocessor control is given. The algorithm foreseen for the check-up of the dosing accuracy of molten metal is considered throughly.

3003 Thermoelectric Generators

Refer also to citation(s) 5598

5764 (DOE/SF/18852–T19) **GPHS-RTGs in support of the Cassini mission: Semi-annual technical report, 30 March 1992–27 September 1992.** General Electric Co., Philadelphia, PA (United States). Astro Space Div. [1992]. 37p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-91SF18852. Order Number DE93002035. Source: OSTI; NTIS; GPO Dep.

The technical progress achieved during the period 30 March through 27 September 1992 on Contract DE-AC03-91SF18852.000 Radioisotope Thermoelectric Generators and Acillary Activities is described herein.

5765 (WHC-SA–1590) **Proposed Strontium Radioisotope Thermoelectric Generator Fuel Encapsulation Facility.** Adkins, H.E. Westinghouse Hanford Co., Richland, WA (United States). Jun 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930103–11: 10. symposium on space nuclear power and propulsion, Albuquerque, NM (United States), 10-14 Jan 1993). Order Number DE92040418. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The propose Fuel Encapsulation Facility is a fully equipped facility for processing and encapsulating strontium Radioisotope Thermoelectric Generator (RTG) fuel from presently available Waste Encapsulation and Storage Facility (WESF) capsules. The facility location is on the second building level below ground of the Fuels and Materials Examination Facility (FMEF), Cells 142, 143, 144, and 145. Capsules containing strontium fluoride (SrF_2) would be received from the WESF in Cell 145 and transferred to the three adjacent cells for processing and encapsulation into the final RTG fuel configuration.

3005 Fuel Cells

Refer also to citation(s) 4874

5766 (DOE/MC/24221–3144) **Advanced water-cooled phosphoric acid fuel cell development: Quarterly technical progress report No. 50, April–June 1992.** International Fuel Cells Corp., South Windsor, CT (United States). Jul 1992. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-88MC24221. (FCR–12383). Order Number DE93003490. Source: OSTI; NTIS; GPO Dep.

The Advanced Water Cooled Phosphoric Acid Fuel Cell Development program is being conducted by International Fuel Cells Corporation (IFC) to improve the performance and minimize the cost of water-cooled, electric utility phosphoric acid fuel cell stacks. The program adapts the existing on-site Configuration B cell design to electric utility operating conditions and introduces additional new design features. Task 1 consists of the conceptual design of a full-scale electric utility cell stack that meets program objectives. Tasks 2 and 3 develop the materials and processes required to fabricate the components that meet the program objective. The design of the small area and two 10-ft^2 short stacks is conducted in Task 4. The conceptual design also is updated to incorporate the results of material and process developments, as well as results of stack tests conducted in Task 6. Fabrication and assembly of the short stacks are conducted in Task 5 and subsequent tests are conducted in Task 6. The Contractor expects to enter into a contract with the Electric Power Research Institute (EPRI) to assemble and endurance test the second 10-ft^2 short stack. The management and reporting functions of Task 7 provide DOE/METC with program visibility through required documentation and program reviews. This report describes the cell design and development effort that is being conducted to demonstrate, by subscale stack test, the technical achievements made toward the above program objectives.

5767 (DOE/MC/26355–93/C0137) **Testing of a multi-kWe SOFC power generation system.** Makiel, J.M.; Shockling, L.A.; Fabis, T.R. Westinghouse Electric Corp., Pittsburgh, PA (United States). Science and Technology Center. [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-89MC26355. (CONF-921114–1: Fuel cell seminar, Tucson, AZ (United States), 29 Nov - 2 dec 1992). Order Number DE93003489. Source: OSTI; NTIS; GPO Dep.

In the last ten years, SOFC generated power has increased from tens of watts from 3 cell stacks to tens of kilowatts from 576 cell stacks. Following this growth in power capability, automatic control systems have been developed which permit unattended operation of these generators. This paper describes a 20 kWe SOFC generator system which was developed under joint sponsorship by Westinghouse and the US Department of Energy and has successfully completed 3,000 hours of operation. Reference 1 presents a description of the design features of this generator as well as the development work which proceeded its construction. The operation of this SOFC generator required continuous control of electrical load, fuel and air flows, and generator temperature. Because of the complex strategy required to control these parameters, a dedicated programmable controller operated the generator. Distinct operating states were defined for start up, stop, and run conditions. During the start up, the operator moved the generator through the operating states by keyboard input from a personal computer operator interface. An indicator on the display screen of the operator interface alerted the operator when a state transition was permissible. In the run state, keyboard input of certain control set points were permitted. The controller continuously monitored the status of critical parameters.

5768 (DOE/MC/27227–93/C0136) **Integration of carbonate fuel cells with advanced coal gasification systems.** Steinfeld, G. (Energy Research Corp., Danbury, CT (United States)); Meyers, S.J.; Hauserman, W.B. Energy Research Corp., Danbury, CT (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-90MC27227. (CONF-921114–3: Fuel cell seminar, Tucson, AZ (United States), 29 Nov - 2 dec 1992). Order Number DE93003485. Source: OSTI; NTIS; GPO Dep.

Carbonate fuel cells have attributes which make them ideally suited to operate on coal-derived fuel gas; they can convert the methane, hydrogen, and carbon monoxide present in coal derived fuel gas directly to electricity, are not subject to thermodynamic cycle limits as are heat engines, and operate at temperatures compatible with coal gasifiers. Some new opportunities for improved efficiency have been identified in integrated coal gasification/carbonate fuel cells which take advantage of low temperature catalytic coal gasification producing a methane-rich fuel gas, and the internal methane reforming capabilities of Energy Research Corporation's carbonate fuel cells. By selecting the appropriate operating conditions and catalyst in the gasifier, methane formation is maximized to improve gasification efficiency and to take advantage of the heat management aspects of the internal reforming carbonate fuel cell. These advanced integrated gasification/carbonate fuel cell systems are projected to have better efficiencies than gasification/carbonate fuel cell systems employing conventional gasification, and also competing non-fuel cell systems. These improved efficiencies would be accompanied by a corresponding reduction in impact on the environment as well.

5769 (DOE/MC/28055–93/C0135) **Recent progress in zirconia-based fuel cells for power generation.** Singhal, S.C. Westinghouse Electric Corp., Pittsburgh, PA (United States). Science and Technology Center. [1992]. 31p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC21-91MC28055. (CONF-9208144–3: 5. international conference on the science and technology of zirconia, Melbourne (Australia), 16-21 Aug 1992). Order Number DE93003488. Source: OSTI; NTIS; GPO Dep.

High temperature solid oxide fuel cells based upon yttria-stabilized zirconia electrolyte offer a clean, pollution-free technology to electrochemically generate electricity at high efficiencies. This paper reviews the designs, materials and fabrication processes used for such fuel cells. Most progress to date has been achieved with tubular geometry cells. A large number of tubular cells have been electrically tested, some to times up to 30,000 hours; these cells have shown excellent performance and performance stability. In addition, successively larger size electric generators utilizing these cells have been designed, built and operated since 1984. Two 25 kW power generation field test units have recently been fabricated; these units represent a major milestone in the commercialization of zirconia-based fuel cells for power generation.

5770 (ECN-C–92-053) **Subtask 6: Recommended practices for powder characterization: IEA Programme on Advanced Fuel Cells, Annex 2: Modelling and evaluation of**

Solid Oxide Fuel Cells. Van Heuveln, F.H.; Huijsmans, J.P.P. (eds.). Netherlands Energy Research Foundation (ECN), Petten (Netherlands). Aug 1992. 29p. Project ECN 2919. Order Number DE93752676. Source: OSTI; NTIS (US Sales Only).

Powders, or precursors of powders, for the fabrication of Solid Oxide Fuel Cell (SOFC) anode-, cathode-, electrolyte- and ceramic interconnect structures are the relevant products to be evaluated. The aim is to provide a standard set of powder properties which have to be measured according to recommended methods and measurement conditions. The set is based on the results of a round robin test for electrolyte powder between five laboratories. The selected powder properties to be measured are chemical composition, phase composition, specific surface, particle size distribution, particle shape, sinterability, powder density, and flowability. The laboratories involved are Cookson Group (United Kingdom), Eniricerche (Italy), Senter for Industriforskning (Norway), Alusuisse/Lonza (Switzerland), and the Netherlands Energy Research Foundation. 2 app., 8 refs.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

Refer also to citation(s) 5379, 5730

3201 Buildings

Refer also to citation(s) 5278, 5284, 5294, 5736, 5757, 5858, 6044, 6045, 6074

5771 (AUC-IBT-R–9204, pp. 111-118) **Risk analysis of air infiltration in the building.** Pietrzyk, K. (Building Aerodynamics Research Group, Chalmers University of Technology, Gothenburg (Sweden)). Aalborg Universitetscenter (Denmark). Inst. for Bygningsteknik. Feb 1992. (CONF-9111281–: 2. Scandinavian forum for stochastic mechanics, Aalborg (Denmark), 21-22 Nov 1991). In *Scandinavian forum for stochastic mechanics.* 170p. Order Number DE93752802. Source: OSTI; NTIS.

Full-scale pressure measurements on a low rise building have been carried out. This paper presents how the results of these measurements can be use to estimate airflow through the structure. An example of calculation of air change rate expressed in air changes per hour (ACH) has been done for one wind direction within a 3-months experiment period. Risk analysis of air infiltration in the building based on ACH distribution has been studied. Safety index β for serviceability condition has been calcuated. (au).

5772 (CONF-9101154–, pp. 74-100) **Solar thermal processes - state of the art and new developments.** Sizmann, R. (Univ. Muenchen (Germany)); Schoelkopf, W. Bayerisches Staatsministerium fuer Wirtschaft und Verkehr, Muenchen (Germany). 1991. 306p. (In German). From Symposium on incentives for using renewable energy sources in Bavaria; Coburg (Germany); 28-29 Jan 1991. In *Incentives for using renewable energy sources in Bavaria. Symposium for users and suppliers (local authorities, public utilities, industry, medium enterprises).* Order Number DE93744689. Source: OSTI; NTIS (US Sales Only).

Heat supply makes up more than 60% of final energy consumption in Germany. More than half of this share concerns heat of a temperature below 100deg C - mostly water and space heating. This is where solar systems may help much to save energy. The collector is but one component of a solar thermal system: tanks, pipings, interfaces to consuming systems, controls are the other components. System design needs to take into account the external influencing factors of meteorology and user behaviour. Bavaria has entered into a number of activities for the utilization of solar energy: indoor-swimming-pool heating, drying of produce, domestic/industrial water heating, hall heating, process heat applications. (BWI).

5773 (CONF-9101154–, pp. 209-222) **Energy management systems, utilization of biomass and solar thermal systems in Upper Palatinate.** Fenzl, J. (Zweckverband 'Regionale Entwicklung und Energie', Regensburg (Germany)). Bayerisches Staatsministerium fuer Wirtschaft und Verkehr, Muenchen (Germany). 1991. 306p. (In German). From Symposium on incentives for using renewable energy sources in Bavaria; Coburg (Germany); 28-29 Jan 1991. In *Incentives for using renewable energy sources in Bavaria. Symposium for users and suppliers (local authorities, public utilities, industry, medium enterprises).* Order Number DE93744689. Source: OSTI; NTIS (US Sales Only).

The objective of the association 'Regional Development and Energy' is to provide consultancy to local authorities in rural and city areas within the catchment region of the association concerning issues of rational energy generation and utilization while considering local energy potentials and innovative technologies. The author presents three focal areas of activities which are well suited for application in rural areas: energy management systems, renewable raw materials/fuels, utilization of solar energy. (BWI).

5774 (CONF-9101154–, pp. 264-272) **The ecological building at Wuerzburg.** Vogel, A. Bayerisches Staatsministerium fuer Wirtschaft und Verkehr, Muenchen (Germany). 1991. 306p. (In German). From Symposium on incentives for using renewable energy sources in Bavaria; Coburg (Germany); 28-29 Jan 1991. In *Incentives for using renewable energy sources in Bavaria. Symposium for users and suppliers (local authorities, public utilities, industry, medium enterprises).* Order Number DE93744689. Source: OSTI; NTIS (US Sales Only).

The office of the Bund Naturschutz in Wuerzburg is a building constructed in accordance with ecological principles and requirements which uses natural building materials preferably. Thermal insulation was executed in a more than average approach to ensure that space heating requirements will be kept low. As far as possible, solar energy was used for energy supply. Hot water was found to be needed at varying quantities; hence, any surplus solar heat can be fed to the heating buffer tank. A solar electric power system largely covers electricity demands. A battery system was installed to compensate variations in loads and production. (BWI).

5775 (CONF-9205279–) **Second national symposium 'Thermal solar energy'.** Ostbayerisches Technologie-Transfer-Institut e.V. (OTTI), Regensburg (Germany). 1992 284p. (In German). From 2. national symposium on thermal solar energy (TSE); Staffelstein (Germany); 14-15 May 1992. Order Number DE93744460. Source: OSTI; NTIS (US Sales Only).

The symposium on thermal solar energy utilization focussed on embracing aspects of thermal solar energy, standardization, testing, quality assurance, and the use of passive solar energy. Each of the 23 papers given at the meeting was abstracted for separate entry into the data base. (BWI).

5776 (CONF-9205279–, pp. 53-62) **The commitment of municipal utilities in the decentralized heat market including solar energy.** Braun, H. (Dortmunder Stadtwerke AG, Abt. Anwendungstechnik, Dortmund (Germany)). Ostbayerisches Technologie-Transfer-Institut e.V. (OTTI), Regensburg (Germany). 1992. 304p. (In German). From 2. national symposium on thermal solar energy (TSE); Staffelstein (Germany); 14-15 May 1992. In *Second national symposium 'Thermal solar energy'.* Order Number DE93744460. Source: OSTI; NTIS (US Sales Only).

In the light of the menacing climate catastrophe, power utilities feel challenged evermore to address the saving of energy also in their sales-economy measures. Pollution control, supply safety, price-worthiness of energy supply, and rational energy utilization are identified as their primary goals. The author reports on the commitment of Dortmunder Statwerke AG involving the following fields: Energy conservation consultancy, local-district-heating service, heat supply, local-district-heating-service plus, planning aids, information on solar systems (flat-plate collectors for multi-family houses and farms; evacuated tube collectors). (BWI).

5777 (CONF-9205279–, pp. 63-71) **The marketing of systems for thermal solar energy.** Weiss, W. (Arbeitsgemeinschaft Erneuerbare Energien, Gleisdorf (Austria)). Ostbayerisches Technologie-Transfer-Institut e.V. (OTTI), Regensburg (Germany). 1992. 304p. (In German). From 2. national symposium on thermal solar energy (TSE); Staffelstein (Germany); 14-15 May 1992. In *Second national symposium 'Thermal solar energy'.* Order Number DE93744460. Source: OSTI; NTIS (US Sales Only).

Given the relatively great share of hydroelectric power in power generation and the early abandonment of nuclear power, Austria stands a good chance to meet the regulatory reduction of CO_2 emissions by 20% by the year 2005. About 45% of total energy is needed to supply low-temperature heat. Calculations indicate that, by the year 2010, thermal solar energy systems will provide up to one quarter of the energy needed in hot water preparation and up to 1 per cent in space heating. However, policy makers in Austria have been slow to promote the application of renewable energy sources. (BWI).

5778 (CONF-9205279–, pp. 73-78) **Product marketing for thermal solar energy systems including promotional measures.** Conze, H. (Stiebel Eltron GmbH und Co. KG, Holzminden (Germany)); Kellner, H. Ostbayerisches Technologie-Transfer-Institut e.V. (OTTI), Regensburg (Germany). 1992. 304p. (In German). From 2. national symposium on thermal solar energy (TSE); Staffelstein (Germany); 14-15 May 1992. In *Second national symposium 'Thermal solar energy'*. Order Number DE93744460. Source: OSTI; NTIS (US Sales Only).

Promotion of the sales market for thermal solar energy systems requires that the customer, too, gets a realistic idea about the efficiency and options of his system. This can be supported by computer simulations which give information on the share of annual solar yield and cost coverage. The Stiebel Eltron company pursues a strategy which involves consultancy of customers by the specialist trade; to this end, its market-oriented product marketing covers the following fields: prospectus material/product information, planning leaflets, posters, training courses, assembly instructions, exhibitions, promotional actions and after-sales service. In addition, governmental promotional measures play an important part in the acceptance of solar systems. (BWI).

5779 (CONF-9205279–, pp. 141-149) **Light, heat, transparency - the approach to sun light in architecture and ecology.** Lichtblau, F. Ostbayerisches Technologie-Transfer-Institut e.V. (OTTI), Regensburg (Germany). 1992. 304p. (In German). From 2. national symposium on thermal solar energy (TSE); Staffelstein (Germany); 14-15 May 1992. In *Second national symposium 'Thermal solar energy'*. Order Number DE93744460. Source: OSTI; NTIS (US Sales Only).

Currently about 500,000 new appartments and flats are needed to be built annually in the old Federal Lander. This means, on the one hand, more pollution of the environment but, on the other hand, a splendid opportunity to use renewable energies. The potential of fossil and nuclear fuel substitution by the total insolation rate in Germany is estimated to be 80% in applications for low-temperature heat, lighting, etc., without causing emissions. Hence, direct gain of light and heat by passive methods should be given priority in the planing of new buildings, though it should be mentioned that so-called "intelligent building envelopes" will have to meet a great number of conflicting demands. (BWI).

5780 (CONF-9205279–, pp. 151-157) **Solar architecture between the horns of dilemma of energy gain versus pleasure gain.** Gabriel, I. Ostbayerisches Technologie-Transfer-Institut e.V. (OTTI), Regensburg (Germany). 1992. 304p. (In German). From 2. national symposium on thermal solar energy (TSE); Staffelstein (Germany); 14-15 May 1992. In *Second national symposium 'Thermal solar energy'*. Order Number DE93744460. Source: OSTI; NTIS (US Sales Only).

The growing public awareness of energy issues and the modified attitude to the environment in recent years have led to the development of low-energy architecture or buildings completely independent in their energy supply. However, a number of mistakes have been made. Buildings are expected to have reduced service lives in the future, a fact which needs to be considered in their designs to allow technological retro-fitting later on. The disposal and re-use of building materials needs to be considered, too. This concerns, in particular, the manufacture and installation of solar systems. (BWI).

5781 (CONF-9205279–, pp. 159-167) **Large-series production of high-efficiency solar collectors.** Lange, D. (Thermo-Solar Energietechnik GmbH, Regensburg (Germany)); Kellner, B. Ostbayerisches Technologie-Transfer-Institut e.V. (OTTI), Regensburg (Germany). 1992. 304p. (In German). From 2. national symposium on thermal solar energy (TSE); Staffelstein (Germany); 14-15 May 1992. In *Second national symposium 'Thermal solar energy'*. Order Number DE93744460. Source: OSTI; NTIS (US Sales Only).

Estimates indicate that 13 million sqm of collector surface might have been installed by 2005 in accordance with the available building and providable manufacturing capacities. However, today's growth rates indicate only 3 million sqm to be expected which means that the potential will not be exploited to its fullest. These objectives will not be achieved unless suitable manufacturing capacities will be available and unless collector designs will allow the special conditions of series manufacturing to be considered as early as the design stage. The authors discuss the preconditions for series production for a new generation of evacuated flat-plate collectors. (BWI).

5782 (CONF-9205279–, pp. 169-188) **Glass in its function - engineering bases for its application.** Blessing, R.G. (Interpane, Lauenfoerde (Germany)). Ostbayerisches Technologie-Transfer-Institut e.V. (OTTI), Regensburg (Germany). 1992. 304p. (In German). From 2. national symposium on thermal solar energy (TSE); Staffelstein (Germany); 14-15 May 1992. In *Second national symposium 'Thermal solar energy'*. Order Number DE93744460. Source: OSTI; NTIS (US Sales Only).

Today glass is a multifunctional building element which can be applied universally, while meeting different functions: protection from heat, sunlight, noise, fire, and unauthorized listeners. Thermal and solar protection insulating glasses are available on today's market in an almost ideal design. The author discusses in detail the invidual functions of insulating glasses. (BWI).

5783 (CONF-9205279–, pp. 189-201) **Transparent thermal insulation in architecture for the home and industrial environments. Possibilities and limits of application.** Braun, P.O. Ostbayerisches Technologie-Transfer-Institut e.V. (OTTI), Regensburg (Germany). 1992. 304p. (In German). From 2. national symposium on thermal solar energy (TSE); Staffelstein (Germany); 14-15 May 1992. In *Second national symposium 'Thermal solar energy'*. Order Number DE93744460. Source: OSTI; NTIS (US Sales Only).

The application of transparent thermal insulation materials as fasade elements provides the first-time opportunity to construct residential buildings in the Central European climate which are largely independent in their heating energy supply. Glazings combined with transparent thermal insulation structures to give so-called daylight elements may also contribute much to the reduction of emissions in the field of "non-residential architecture". Architecture can draw on another building element which allows new design options. The results of 10 years of research and development point to this technology as one vital component for energy conversation schemes to protect the environment. (orig.).

5784 (CONF-9205279–, pp. 105-118) **'Low flow' - options and limits in a system development.** Fuenfgeld, C. (Inst. fuer Solarenergieforschung Hameln/Emmerthal GmbH (ISFH), Emmerthal (Germany)); Mack, M. Ostbayerisches Technologie-Transfer-Institut e.V. (OTTI), Regensburg (Germany). 1992. 304p. (In German). From 2. national symposium on thermal solar energy (TSE); Staffelstein (Germany); 14-15 May 1992. In *Second national symposium 'Thermal solar energy'*. Order Number DE93744460. Source: OSTI; NTIS (US Sales Only).

Low Flow systems, i.e. collector systems with a much reduced flow in the solar circuit, are to allow collector-outlet feed to the storage system to be matched to temperature. The concept is based on several ideas for the prevention of heat losses and for the minimization of component and installation costs. However, the benefit of such a system over today's domestic-water heating systems available as fairly well developed options in the market, was still unclear. The authors report on parallel, continuous measurements performed on a standard system and on a fully comparable LOW FLOW prototype, while recording i.a. also the temperature stratification in the storage tank. Diurnal profiles of collector and storage temperatures and the results of long-term measurement periods are used to discuss the options and limits of this concept. Whereas the energy benefit was found to be much less than expected, the cost-savings potentials were found to be quite attractive. (orig.).

5785 (CONF-9205279–, pp. 203-212) **Minimization of the energy requirements of an office building by the use of transparent thermal insulation technology and dynamic simulation of buildings.** Hoffmann, G. (UECONSULT GmbH, Frechen (Germany)); Molitor, K. Ostbayerisches Technologie-Transfer-Institut e.V. (OTTI), Regensburg (Germany). 1992. 304p. (In German). From 2. national symposium on thermal solar energy (TSE); Staffelstein (Germany); 14-15 May 1992. In *Second national symposium 'Thermal solar energy'*. Order Number DE93744460. Source: OSTI; NTIS (US Sales Only).

A significant energy conversation for an office building as well as utilization of solar energy by active and passive solar systems was achieved by way of a cooperation with the architect at an early planning stage and by means of an integrated, dynamic simulation programme for buildings. Today, architects can make use of services and computer programmes to find answers to the following issues: prevention of project-planning mistakes (sick building syndrome due to overheating), - minimization of refrigeration energy demand; - minimization of heating energry demand. The authors point out that this integrated energy concept allows CO_2 emissions to be reduced considerably compared to a standard building because of its optimized building envelope based on building physics and because of its application of innovative solar systems. (orig./ BWI).

5786 (CONF-9205279–, pp. 229-240) **Low-energy buildings.** Feist, W. (Institut Wohnen und Umwelt, Darmstadt (Germany)). Ostbayerisches Technologie-Transfer-Institut e.V. (OTTI), Regensburg (Germany). 1992. 304p. (In German). From 2. national symposium on thermal solar energy (TSE); Staffelstein (Germany); 14-15 May 1992. In *Second national symposium 'Thermal solar energy'*. Order Number DE93744460. Source: OSTI; NTIS (US Sales Only).

low-energy buildings are characterized by the following methods adopted for energy minimization: excellent thermal protection of all external components, conscientious execution of every detail of thermal insulation, reduction of the external suface area, passive utilization of solar energy, and heating system matched to the building. Experience have shown, that the additional costs are about 4-7% of building costs. In addition, low energy buildings have a comfortable thermal radiation climate due to the excellent insulation of the external components. (BWI).

5787 (CONF-9205279–, pp. 249-258) **In the test chamber: A facade-integrated air-collector latent-storage system for space heating.** Manz, H. (Eidgenoessische Materialpruefungs- und Forschungsanstalt, Duebendorf (Switzerland)); Egolf, P.W. Ostbayerisches Technologie-Transfer-Institut e.V. (OTTI), Regensburg (Germany). 1992. 304p. (In German). From 2. national symposium on thermal solar energy (TSE); Staffelstein (Germany); 14-15 May 1992. In *Second national symposium 'Thermal solar energy'*. Order Number DE93744460. Source: OSTI; NTIS (US Sales Only).

The authors report on a compact air-collector latent-storage system to use solar energy for space heating. The short-term storage tank arranged directly downstream of the air collector is actively charged by a closed-loop air circuit and gives off its heat passively through a wall structure into the adjacent room. Measurements were performed on this system at EMPA under real climate conditions for several months. The authors present the test set-up and some initial measurement results. A validated simulation programme which was developed for just this system, was used to calculate energy gains for complete heating periods in two different climate regions of Switzerland. (orig.).

5788 (CONF-9205279–, pp. 259-268) **Modernization and optimization of a 105 sqm solar system for industrial water heating.** Schmalschlaeger, T. (Stadtwerke Muenchen, Stabsstelle Energiesparen (Germany)); Klimt, J. Ostbayerisches Technologie-Transfer-Institut e.V. (OTTI), Regensburg (Germany). 1992. 304p. (In German). From 2. national symposium on thermal solar energy (TSE); Staffelstein (Germany); 14-15 May 1992. In *Second national symposium 'Thermal solar energy'*. Order Number DE93744460. Source: OSTI; NTIS (US Sales Only).

In 1987, the Maintenance and Repair section of the Munich Underground system was commissioned. On the roof of its shed measuring 100 x 200 sqm, a solar system was installed, featuring a total collector surface area of 105 sqm. The collectors heat the industrial water needed in the main workshop. The waste heat produced by the two pressurized air compressors is used, too. In case of insufficient solar irradiation, the temperature level of the water can be boosted by means of a close-range-district heating system from the boiler house of the M and R Section. The latter system is fuelled with natural gas and has an output of 11 MW. Investigations into the actual situation of the installations quickly revealed engineering flaws in the planning for and execution of marginal conditions as well as technical problems. An automated measurement data collection system was installed at the end of 1990 as a first-time remedical action to provide a more detailed picture. (orig./ BWI).

5789 (CONF-9205279–, pp. 269-278) **Planning of and experience with a solar building implemented by way of efficient and continuously cost-effective technologies.** Delzer, S. (Ing.-Buero fuer Technische Kybernetik und Energietechnik, Loerrach (Germany)); Fischbach, H.P. Ostbayerisches Technologie-Transfer-Institut e.V. (OTTI), Regensburg (Germany). 1992. 304p. (In German). From 2. national symposium on thermal solar energy (TSE); Staffelstein (Germany); 14-15 May 1992. In *Second national symposium 'Thermal solar energy'*. Order Number DE93744460. Source: OSTI; NTIS (US Sales Only).

Accurate planning effected by means of the dynamic simulation programme developed by the authors' engineering office in 1985, allowed various individual passive and active systems to be compared for their respective merits in ecology-responsive building relative to the construction of their single-family-housecum-granny-flat. The outcome was a house featuring low consumption of fossil energy and high living quality in conjunction with ecological, economic and aesthetic aspects. 4 years of living in this house showed good agreement between predicted and actual energy consumption. (orig.).

5790 (CONF-9209244–1) **Environmental tobacco smoke.** Guerin, M.R.; Jenkins, R.A. Oak Ridge National Lab., TN (United States). [1992]. 13p. Sponsored by National Cancer Inst., Bethesda, MD (United States). DOE Contract AC05-84OR21400. From Tobacco chemists' research conference; Montreal (Canada); 27-30 Sep 1992. Order Number DE93001376. Source: OSTI; NTIS; GPO Dep.

Environmental tobacco smoke (ETS) is the material in indoor air which results from tobacco smoking. Early work on the chemistry of ETS and on estimates of the resulting human exposure relied heavily on studies of sidestream smoke, on the characterization of highly contaminated environments, and on the use of contained experimental atmospheres. It had also been common practice to equate ETS with mainstream smoke for purposes of risk assessments. More recent work has identified potentially important differences between the properties of ETS and those of mainstream smoke. Recent work has also included major surveys of commonly encountered smoking and nonsmoking environments for their indoor air concentrations of, particularly, nicotine, carbon monoxide, and/or respirable suspended particulate matter (RSP). Studies have also now been reported which address the general composition of the particulate and vapor phases of ETS and which measure concentrations of trace and miscellaneous constituents of tobacco smoke in indoor air. The data demonstrate that tobacco smoking clearly contributes to indoor air contamination but that the contribution is often less than was previously assumed for the more-commonly encountered environments. The data also identify difficulties in the use of nicotine, carbon monoxide, and RSP as surrogate measures of ETS as a whole. This paper summarizes recent observation concerning the measurement and concentrations of ETS constituents in indoor air.

5791 (DOE/CE/27504–4) **Energy savings from operation and maintenance training for apartment boiler heating systems: An energy study on ten low-income apartments.** Urban Consortium for Technology Initiatives (United States). Energy Task Force; Public Technology, Inc., Washington, DC (United States); Portland Energy Office, OR (United States). Feb 1992. 78p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90CE27504. Order Number DE93005610. Source: OSTI; NTIS; INIS; GPO Dep.

The Portland Energy Office provided operation and maintenance (O&M) training to the operators of boiler heating systems for ten low-income apartment complexes in the Fall of 1990. This study tracked energy usage before and after O&M training to see if savings occurred. Training was provided on both weatherized and non-weatherized apartments to find out if weatherization impacted the amount of O&M savings to be obtained. Also, energy savings from the O&M training and building shell weatherization are compared. The O&M training averaged about four hours per building. Content was adjusted at each site to match needs of the boiler and operator. The Energy Office also provided a boiler tune-up by a service technician. The training stressed low-cost and no-cost measures which operators could either do themselves or hire service help to implement. It also emphasized boiler safety. Nine of the ten apartment complexes in the study used less energy per heating degree-day after the O&M help. Average savings were 10%. Four apartments chosen randomly as controls had negative savings; they used slightly more energy during the same post-O&M time frame. Weatherized and unweatherized apartments showed similar savings after the O&M help, 10% and 11% percent respectively. Savings from weatherization of six of the apartments in the winter of 1988–1989 were also measured. A low average of only 4% was observed, reflecting negative savings in two buildings.

5792 (DOE/CE/27504–T1) **Sustainable systems rating program: Marketing "Green" Building in Austin, Texas.** Urban Consortium for Technology Initiatives (United States). Energy Task Force; Public Technology, Inc., Washington, DC (United States); Austin Environmental and Conservation Services Dept., TX (United States). Dec 1991. 98p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90CE27504. Order Number DE93005619. Source: OSTI; NTIS; INIS; GPO Dep.

Four major resource issues for home construction were identified: water, energy, materials, and waste. A systems flow model was then developed that tracked the resource issues through interactive matrices in the areas of sourcing, processing, using, and disposing or recycling. This model served as the basis for a rating system used in an educational and marketing tool called the Eco-Home Guide.

5793 (DOE/CE/27504–T2) **Tucson Solar Village: Project management: A project in sustainable community development.** Urban Consortium for Technology Initiatives (United States). Energy Task Force; Public Technology, Inc., Washington, DC (United States); Pima County Manager's Office, Tucson, AZ (United States). Nov 1991. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90CE27504. Order Number DE93004225. Source: OSTI; NTIS; INIS; GPO Dep.

The Tucson Solar Village is a Design/Build Project In Sustainable Community Development which responds to a broad spectrum of energy, environmental, and economic challenges. This project is designed for 820 acres of undeveloped State Trust Land within the Tucson city limits; residential population will be five to six thousand persons with internal employment provided for 1200. This is a 15 year project (for complete buildout and sales) with an estimated cost of $500 million. Details of the project are addressed with emphasis on the process and comments on its transferability.

5794 (DOE/CE/28313–T2) **Small Commercial Program DOE Project: Impact evaluation: Final report.** Bathgate, R. (Energy and Solid Waste Consultants, Montpelier, VT (United States)); Faust, S. Energy and Solid Waste Consultants, Montpelier, VT (United States). 12 Aug 1992. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG01-89CE28313. Order Number DE93006139. Source: OSTI; NTIS; GPO Dep.

In 1991, Washington Electric Cooperative (WEC) implemented a Department of Energy grant to conduct a small commercial energy conservation project. The small commercial "Mom, and Pop" grocery stores within WEC's service territory were selected as the target market for the project. Energy & Solid Waste Consultant's (E&SWC) Impact Evaluation is documented here. The evaluation was based on data gathered from a variety of sources, including load profile metering, kWh submeters, elapsed time indicators, and billing histories. Five stores were selected to receive measures under this program: Waits River General Store, Joe's Pond Store, Hastings Store, Walden General Store, and Adamant Cooperative. Specific measures installed in each store and description of each are included.

5795 (EDF-R–92-NI-M-0007) **For high-quality ventilation in new housing.** Electricite de France (EDF), 92 - Clamart (France). Sep 1990. 36p. (In French). Source: OSTI; NTIS (US Sales Only).

After introductory considerations on ventilation needs, this memorandum contains a critical evaluation of existing ventilation systems. Single or double flow mechanical ventilation, ventilation adjustable according to the relative air humidity as well as natural ventilation are described with their respective advantages and drawbacks. Five ways of improving ventilation in the future are discussed: informing users, training fitters, promoting collaboration between constructors, approaching designers and house builders and setting up a structure to have only one man in charge of ventilation on construction sites, quality controls and training methods adapted to the specific jobs involved. The present trend in research towards forced ventilation is also examined. Finally, the memorandum addresses the problem of perturbation sources: tumble dryer, cooker hood and fireplace. Recommendations are made as regards the installation of individual mechanical ventilation systems, the detection of in leakage points, points vulnerable to leaks and the plant maintenance. 18 refs.

5796 (ETDE-mf–93744443) **Use of different evaporator plates at the heat pump plant Esslingen, Scheiztorstrasse. Final report.** Vereinigte Esslinger Wohnungsunternehmen GmbH, Esslingen (Germany); Bundesministerium fuer Forschung und Technologie, Bonn (Germany). 9 Feb 1983 2p. (In German). Contract BMFT 03E5084G. Order Number DE93744443. Source: OSTI; NTIS (US Sales Only).

The described research project deals with the use of different evaporator plate systems for studying and evaluating the effect of varying water quality on different materials. Galvanized evaporator plates with a plastic material coating have not stood the test because the coating failed to adhere properly. Saekaphen-coated plates attracted crustacea - without perceivable damage being caused so far. V 2 A and V 4 A plates are flawless up to now and are therefore recommended for such uses. (BWI).

5797 (LBL–32638) **Utility and economic benefits of electrochromic smart windows.** Warner, J.L. (Lawrence Berkeley Lab., CA (United States)); Reilly, M.S.; Selkowitz, S.E.; Arasteh, D.K.; Ander, G.D. Lawrence Berkeley Lab., CA (United States). Jun 1992. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-920828–21: American Council for an Energy-Efficient Economy (ACEEE) summer study on energy efficiency in buildings, Pacific Grove, CA (United States), 30 Aug - 5 sep 1992; BS–290). Order Number DE93002565. Source: OSTI; NTIS; GPO Dep.

Windows have very significant direct and indirect impacts on building energy consumption, load shape, and peak demand. Electrochromic switchable glazings can potentially provide substantial reductions in all aspects of cooling and lighting electricity usage. The solar-optical properties of electrochromic coatings vary over a wide range in response to an applied electrical signal. This control signal can be driven by a Combination of occupant needs, external environmental conditions, building operating strategies, and electricity demand minimization requirements. The impact of an electrochromic glazing depends on the intrinsic properties of the coating, the placement of the coating within a window system, and many parameters related to building type, operating strategy, orientation, and location. This study explores the potential benefits of electrochromics in comparison to other currently available and emerging glazing technologies. These effects are explored in office buildings in several climates as a function of window size, orientation, and building operating characteristics. The DOE-2 building energy simulation program was used to model the performances of these dynamic coatings, accounting for both thermal and daylighting impacts. Very substantial savings are demonstrated compared to conventional glazings, but specific impacts on component and total energy consumption, peak demand, and HVAC system sizing vary widely among the options analyzed. In a hot, sunny climate, simple payback periods of three to ten years were calculated. Electrochromic glazings appear to represent a very important future building design option that will allow architects and engineers a

high degree of design freedom to meet occupant needs, while minimizing operating costs to building owners and providing a new and important electricity demand control option for utilities. Utility demand-side management programs can accelerate the market penetration of electrochromics by offering incentives to reduce net first cost and payback periods.

5798 (NEFF–349/FN-2.331-0.86-Syn.) **Applying stochastic methods to building thermal design and control: Synthesis report (1987 - 1989).** Scartezzini, J.L. (Solar Energy and Building Physics Laboratory, Ecole Polytechnique Federale de Lausanne (CH)); Bottazzi, F.; Nygard-Ferguson, M. Nationaler Energie-Forschungs-Fonds (NEFF), Basel (Switzerland). 1990. 30p. Order Number DE90513606. Source: OSTI; NTIS (US Sales Only); NEFF Secretariat, P.O. Box 1564, CH-4001 Basel, Switzerland.

The object of this project is to develop numerical tools based on stochastic methods, issued from the theory of probability. Two objectives have been identified: I. The development of stochastic simulation techniques for thermal design and analysis of passive solar systems and buildings; II. The development of strategies for predictive controllers which can account for the stochastic behaviour of the weather and the occupants of buildings. The advantage of the stochastic approach is to treat the weather evolution and occupants behaviour by their probabilities. Previously to this work, an important effort was made towards the development of a stochastic approach to numerical simulations of passive solar systems. A smaller project has also treated the application of stochastic methods to predictive building thermal control. Encouraging results were obtained. They gave however rise to questions studied within the framework of this project: Design and analysis (hybrid dynamic simulation, Markovian stochastic simulation), predictive control. Two different institutions of the Swiss Federal Institute of Technology in Lausanne collaborate in this project: The 'Solar Energy and Building Physics Laboratory (LESO-PB)' in the Physics Department and the 'Chair of Operations Research' in the Mathematics Department. This document is a synthesis report of the work carried out within the project 'Application des methodes stochastiques: dimensionnement et regulation (Phase I)'. A detailed description of the results is available in French. (author) 20 figs., 10 refs.

5799 (NREL/TP–254-4147) **Desiccant cooling: State-of-the-art assessment.** Pesaran, A.A.; Penney, T.R.; Czanderna, A.W. National Renewable Energy Lab., Golden, CO (United States). Oct 1992. 207p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE93000013. Source: OSTI; NTIS; GPO Dep.

The objectives of this document are to present an overview of the work accomplished to date on desiccant cooling to provide assessment of the state of the art of desiccant cooling technology in the field of desiccant material dehumidifier components, desiccant systems, and models. The report also discusses the factors that affect the widespread acceptance of desiccant cooling technology. This report is organized as follows. First, a basic description and historical overview of desiccant cooling technology is provided. Then, the recent research and development (R&D) program history (focusing on DOE's funded efforts) is discussed. The status of the technology elements (materials, components, systems) is discussed in detail and a preliminary study on the energy impact of desiccant technology is presented. R&D needs for advancing the technology in the market are identified. The National Renewable Energy Laboratory's unique desiccant test facilities and their typical outputs are described briefly. Finally, the results of a comprehensive literature search on desiccant cooling are presented in a bibliography. The bibliography contains approximately 900 citations on desiccant cooling.

5800 (NREL/TP–432-5182) **Research and development needs for desiccant cooling technology 1992–1997: (Supplement to the NREL report, Desiccant Cooling: State-of-the-Art Assessment).** Pesaran, A.A. National Renewable Energy Lab., Golden, CO (United States). Dec 1992. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE93000046. Source: OSTI; NTIS; GPO Dep.

This report is a supplement to Desiccant Cooling: State-of-the-Art Assessment (NREL/TP-254-4147, DE93000013). In this supplement document we have described a detailed program assuming sufficient funding to implement the R&D activities needed. Desiccant dehumidification is a mature technology for industrial applications, and in recent years the technology has been used for air conditioning a number of institutional and commercial buildings. Our proposal is based on argumentative discussions at various national meetings with leaders of the technology. The goal is the penetration of the broad air conditioning market. This work is funded by the Buildings technology Office of the US Department of Energy.

5801 (ORNL/CON–308) **Moisture effects in low-slope roofs: Drying rates after water addition with various vapor retarders.** Pedersen, C.R. (Technical Univ. of Denmark, Lyngby (Denmark)); Petrie, T.W.; Courville, G.E.; Desjarlais, A.O.; Childs, P.W.; Wilkes, K.E. Oak Ridge National Lab., TN (United States). Oct 1992. 131p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93003591. Source: OSTI; NTIS; GPO Dep.

Tests have been conducted in the Large Scale Climate Simulator (LSCS) of the US. Building Envelope Research Center at the Oak Ridge National Laboratory (ORNL) to investigate downward drying rates of various unvented, low-slope roof systems. A secondary objective was to study heat flow patterns so as to understand how to control latent heat effects on impermeable heat flux transducers. Nine test sections were tested simultaneously. The sections had a p deck above fibrous-glass insulation and were examples of cold-deck systems. These five sections had various vapor retarder systems on a gypsum board ceiling below the insulation. The other four sections had a lightweight insulating concrete deck below expanded polystyrene insulation and the same vapor retarder systems, and were examples of warm-deck systems. The cold-deck systems had materials that were relatively permeable to water vapor, while the materials in the warm-deck systems were less permeable. All test sections were topped by an impermeable roofing membrane. The test sections were instrumented with thermocouples between all layers and with small heat flux transducers at the bottom and top of the fibrous-glass insulation and in the middle of the expanded polystyrene insulation. Two different kinds of moisture probes were used to qualitatively monitor the movement of the moisture. The heat flux measurements showed that heat conduction dominates the system using impermeable insulation materials, with only a slight increase due to increased thermal conductivity of wet expanded polystyrene. There was significant transfer of latent heat in the test sections with permeable insulation, causing the peak heat fluxes to increase by as much as a factor of two. With temperatures imposed that are typical of summer days, latent heat transfer associated with condensation and evaporation of moisture in the test sections was measured to be as important as the heat transfer by conduction.

5802 (ORNL/CON–309) **An assessment of desiccant cooling and dehumidification technology.** Mei, V.C. (Oak Ridge National Lab., TN (United States)); Chen, F.C.; Lavan, Z.; Collier, R.K. Jr.; Meckler, G. Oak Ridge National Lab., TN (United States). Jul 1992. 132p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93002622. Source: OSTI; NTIS; GPO Dep.

Desiccant systems are heat-actuated cooling and dehumidification technology. With the recent advances in this technology, desiccant systems can now achieve a primary energy coefficient of performance (COP) between 1.3 and 1.5, with potential to go to 1.7 and higher. It is becoming one of the most promising alternatives to conventional cooling systems. Two important and well-known advantages of desiccant cooling systems are that they are CFC free and they can reduce the electricity peak load. Another important but lesser-known advantage of desiccant technology is its potential for energy conservation. The energy impact study in this report indicated that a possible 13% energy saving in residential cooling and 8% in commercial cooling is possible. Great energy saving potential also exists in the industrial sector if industrial waste heat can be used for desiccant regeneration. The latest study on desiccant-integrated building heating, ventilating, and air conditioning (HVAC) systems indicated that the initial cost for the conventional cooling equipment was greatly reduced by using desiccant technology because of downsized compressors, fans, and ductworks. This cost

reduction was more than enough to offset the cost of desiccant equipment. Besides, the system operation cost was also reduced. All these indicate that desiccant systems are also cost effective. This study provides an updated state-of-the-art assessment forsiccant technology in the field of desiccant materials, systems, computer models, and theoretical analyses. From this information the technology options were derived and the future research and development needs were identified. Because desiccant technology has already been applied in the commercial building sector with very encouraging results, it is expected that future market breakthroughs will probably start in this sector. A market analysis for the commercial building application is therefore included.

5803 (ORNL/CON–317) **The Oklahoma Field Test: Air-conditioning electricity savings from standard energy conservation measures, radiant barriers, and high-efficiency window air conditioners.** Ternes, M.P.; Levins, W.P. Oak Ridge National Lab., TN (United States). Aug 1992. 120p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93003668. Source: OSTI; NTIS; GPO Dep.

A field test involving 104 houses was performed in Tulsa, Oklahoma, to measure the air-conditioning electricity consumption of low-income houses equipped with window air conditioners, the reduction in this electricity consumption attributed to the installation of energy conservation measures (ECMS) as typically installed under the Oklahoma Weatherization Assistance Program (WAP), and the reduction achieved by the replacement of low-efficiency window air conditioners with high-efficiency units and the installation of attic radiant barriers. Air-conditioning electricity consumption and indoor temperature were monitored weekly during the pre-weatherization period (June to September 1988) and post-weatherization period (May to September 1989). House energy consumption models and regression analyses were used to normalize the air-conditioning electricity savings to average outdoor temperature conditions and the pre-weatherization indoor temperature of each house. The following conclusions were drawn from the study: (1) programs directed at reducing air-conditioning electricity consumption should be targeted at clients with high consumption to improve cost effectiveness; (2) replacing low-efficiency air conditioners with high-efficiency units should be considered an option in a weatherization program directed at reducing air-conditioning electricity consumption; (3) ECMs currently being installed under the Oklahoma WAP (chosen based on effectiveness at reducing space-heating energy consumption) should continue to be justified based on their space-heating energy savings potential only; and (4) attic radiant barriers should not be included in the Oklahoma WAP if alternatives with verified savings are available or until further testing demonstrates energy savings or other benefits in this typo of housing.

5804 (TYOT-MON–3/1991) **Electrically heated detached houses with fireplaces fired by indigenous fuels: A nationwide survey conducted in 1988.** Tuomi, S. Work Efficiency Inst., Helsinki (Finland). May 1991. 90p. (In Finnish). Order Number DE93752933. Source: OSTI; NTIS.

An inventory of the fireplaces fired by indigenous fuels in electrically heated detached houses was made in the study carried out in the Department of Forestry of the Work Efficiency Institute (WEI). Their use and obstructions to their use were clarified as was their significance in levelling electricity consumption peaks. In addition, the study clarified the amounts of electricity, wood and peat consumed, the procurement of firewood, and the house owners' opinions as to their future method of heating their houses. The material was collected by the means of a nationwide mail questionnaire addressed to 7 099 owners of detached houses in the spring 1988. The basic population of 827 000 houses was made up of all one and two-dwelling detached houses built before 1986. Of these 235 000 were electrically heated. Three out of four electrically heated houses (i.e. about 180000) had some kind of a fireplace fired by indigenous fuels. Such fireplaces were more common in the newer houses. There was an average of 1.5 fireplaces per electrically heated house. 8 % of these fireplaces had not been used for over a year. The leading obstacle to using the fireplace was its labouriousness, this was reported by 85 % of the respondents. Depending on the manner of heating, an average equivalent of 4.9 to 7.4 m^3 of birch firewood was used in electrically heated houses in 1987. One of the two using both direct electricity and wood for heating their houses did not consciously change their accustomed manner of heating during cold winter days by reducing their consumption of electricity. One of five using electricity to heat their houses used wood only during cold spells.

5805 (TYOT-MON–4/1991) **The use of fireplaces fired by indigenous fuels in electrically heated detached houses.** Kouki, J. Work Efficiency Inst., Helsinki (Finland). May 1991. 53p. (In Finnish). Order Number DE93752934. Source: OSTI; NTIS.

The Department of Forestry of the Work Efficiency Institute monitored 10 electrically heated households with wood-fired fireplaces as auxiliary heat sources in the Nurmijaervi municipality. The monitoring covered four months, the period 11.12.1990 - 10.04.1991. Each household recorded the events connected to heating and weighed the amount of wood they used. Additionally, the power consumption in each household was measured at intervals of one hour. The purpose of the study was to clarify the use of fireplaces in electrically heated houses and the possibilities for levelling power consumption peaks. This was accompanied by detecting the heating habits, the current situation in using the fireplaces and future plans. Each household monitored had a heat retaining hearth and a wood heated sauna. Five of the houses had wood-fired kitchen ranges and seven had wood-fired stoves. The heat retaining hearths were the most important source of auxiliary heat and they were used on the average 1.8 times a week. An average of 25 kg of wood was consumed weekly by heat retaining hearths. The firewood used in the households was usually a mixture of species with moisture contents varying in between 20 - 30 %. In the households monitored, wood compensated electricity on average 19 %. Heat retaining hearths made it possible to achieve reductions of 1 - 2 kW of power consumption peaks. Wood heating was not consciously timed to coincide with power consumption peaks. The time of heating up of fireplaces was determined mainly by the time of a day when members of the family returned home from work. The users were generally satisfied with direct electrical heating and wood-fired fireplaces. Eight out of ten households monitored would choose the present heating system if they were to build a new house.

5806 (VTT-PUB–89) **Analysis of upward flame spread: Project 5 of the EUREFIC fire research programme.** Baroudi, D. (Technical Research Centre of Finland, Espoo (Finland). Fire Technology Lab.); Kokkala, M. Technical Research Centre of Finland, Espoo (Finland). 1992. 50p. Order Number DE93752850. Source: OSTI; NTIS.

Upward flame spread on wall linings is analyzed theoretically with special emphasis on the application of the models to predict whether the flame spread will be deceleratory or acceleratory. Much of the work is devoted to a revised application of the model by Saito et al. By applying carious analytical expressions for the rate of heat release, quantitative expressions for the flame spread velocity are derived. Criteria for accelerating flame spread are presented. Due to the lack of large-scale flame spread tests, the predictions are compared with material data and room fire test results in Swedish BRANDFORSK test series on wall lining materials and in the EUREFIC programme.

5807 (VTT-TIED–1337) **An emulator for testing HVAC-control and energy management: A technical description.** Laitila, P. (Technical Research Centre of Finland, Espoo (Finland). Lab. of Heating and Ventilation); Kaerki, S.; Piira, K.; Katajisto, K.; Kohonen, R. Technical Research Centre of Finland, Espoo (Finland). 1992. 65p. (In Finnish). Order Number DE93752857. Source: OSTI; NTIS.

This report presents a technical description of an emulator for control and energy systems developed in the Heating and Ventilation Laboratory of the Technical Research Centre of Finland (VTT). The examples of existing HVAC emulators are also presented in this report. 'The Development of a Test Procedure for Building Automation Systems' is one of the key areas of BEMS research within the LVIS-2000 research programme, financed by the Ministry of Trade and Industry. The emulator is made up of both physical components and numerical models programmed for a computer. In VTT's emulator, the building and its internal and external heat and moisture loads are numerical models in all cases, if they include in

the system under study. VTT's emulator can be used to study control equipment and energy management systems as well as other devices such as heat-producing equipment. This is facilitated by the emulator's physical test equipment, which comprises an exchangeable heat-producing device, two separate cooling water systems and their heat exchangers, and the mains water supply. At the hart of the emulator's ADP hardware there are two microcomputers linked by the ethernet line. The TRNSYS simulation software has been installed in one of the microcomputers, and the GENESIS process control program in the other. GENESIS is not needed for running the emulation. The process interface equipment and simulation software are connected to one another via their RS-232 serial ports. The performance functionality of the emulator was tested by investigating the control of an air conditioning system with a commercial controller (substitution).

5808 (VTT-TIED–1356) **Craw space floors in multistorey buildings.** Nieminen, J. (Technical Research Centre of Finland, Espoo (Finland). Building Materials Lab.); Kauppi, A. Technical Research Centre of Finland, Espoo (Finland). 1992. 34p. (In Finnish). Order Number DE93752861. Source: OSTI; NTIS.

Field measurements in the crawl spaces of multistorey buildings showed these to be satisfactorily ventilated. In eight of nine buildings the air exchange rates of the crawl spaces were 0.3- 1.1 l/s per square metre of crawl space area. In one of the buildings the crawl space was totally unventilated. Crawl space air temperatures varied from 9-14 deg C in winter to 15-22 deg C in late summer. Condensation occurred occasionally or throughout the year on the foundation base walls or lower surface of the floor in six buildings. Evaporation of moisture from the crawl space ground was the most important factor affecting the crawl space climate. According to the results it is impossible to control effectively the air humidity in a crawl space solely by ventilation of the crawl space.

5809 (VTT-TIED–1380) **Temperatures of two glazed roofs.** Hemmilae, K. (Technical Research Centre of Finland, Espoo (Finland). Building Materials Lab.). Technical Research Centre of Finland, Espoo (Finland). 1992. 50p. (In Finnish). Order Number DE93752868. Source: OSTI; NTIS.

The purpose of the study was to determine temperature variations in glazed roofs. Temperatures were measured in two buildings: the offices of Lasitukku Oy and the Siuntion Kylpylae bathing establishment of special interest were temperature differences between day and night, maximum and minimum temperatures, temperature distributions in the roof, maximum heating and cooling rate, and occurance of water vapour condensation on inner or outer surfaces. The results showed the maximum temperature difference between day and night to be 50 deg C and maximum temperature variations during the time of measurement 80 deg C. The maximum temperature of the outer surface was 66 deg C and the minimum temperature -22 deg C. Metallic roofs parts were of equal temperature +- deg C in both winter and summer. Maximum heating rates of outer surfaces were 10-13 deg C/h and minimum cooling rates 15-25 deg C/h. No water condensation was observed on either surfaces of the roofs. In Lasitukku Oy the roof glass is a sealed double-pane unit, the inner pane being electrically heated. This minimizes the risk of condensation At Siuntion Kylpylae the roof glass is a sealed triple-pane unit In Siuntion Kylpylae condensation would have occurred during the coldest night according to calculations if the relative humidity of the inside air had been 35 % or more. Unequal heating and different thermal expansion coefficients of materials cause bending and stresses in the glass, frames and sealings. Temperature differences between the edge and middle of the glass pane causes stresses in the glass. Temperature variations of a sealed glass unit cause variation in pressure, giving rise to stress in the edge sealing compound and shortening the life of the sealed glass unit. High temperatures, major temperature difference between night and day, and high cooling and heating rates cause stresses in sealing compounds and weather strips, and were the most important stress factors observed in this study.

5810 (VTT-TIED–1383) **Structural evaluation for glazed structures: Methods and test results.** Hassinen, P. (Technical Research Centre of Finland, Espoo (Finland). Lab. of Structural Engineering); Mantere, L.; Saarimaa, J.; Hemmilae, K.; Rautiainen, L. Technical Research Centre of Finland, Espoo (Finland). 1992. 169p. (In Finnish). Order Number DE93752867. Source: OSTI; NTIS.

Structures of glazed facades and roofs are composed of many components like load-bearing beam or struss structures, aluminium profile systems, light transparent glass or plastic covering-plates and sealings. In this report the design principles for the load-bearing capacity of aluminium profiles, glass and plastic covering-plates and elements and sealings are first reviewed. Then experimental results for the stiffness and strength of the joints between the steel and aluminium components are presented and the performance of the joints are evaluated in cases when aluminium profiles are used as stabilizing structures or composite members together with the steel structure. During the research project a glass structure of dimensions 2 450 x 2 450 mm was tested using various temperatures and pressures in laboratory conditions. The tests produced new results about the displacements in the different joints in the structure. Such displacements are repeated thousands of times during the life-time of a structure and have effects on its mechanical behaviour as well as its air- and the water-tightness. The results are used in developing calculation and evaluation models for glazed structures. The last part of the report presents an evaluation method, which was developed for the design and manufacturing stages. In the method first requirements are given for all the important properties of the structure. The fulfilment of these requirements during the manufacturing process is followed with calculations, tests and other standardized or non-standardized assessment methods.

5811 (VTT-TIED–1384) **Development trends of glazed facades and roofs.** Hassinen, P. (Technical Research Centre of Finland, Espoo (Finland). Lab. of Structural Engineering); Mantere, L.; Rautiainen, L.; Nissilae, R.; Hemmilae, K. Technical Research Centre of Finland, Espoo (Finland). 1992. 148p. (In Finnish). Order Number DE93752869. Source: OSTI; NTIS.

Glazed facades and roofs have been developed and their use has increased considerably in recent years in Finland. In this report the possible material and structural developments in glazed structures in the next few years are examined. On the material and component level, the development of glazing and plastic-based units has been evaluated. Further, the future technical properties of fibre-reinforced and aluminium composite frame structures as well as development prospects for sealants and gaskets have been considered. Glazed facades and roofs are relatively new building elements in the Finnish building industry and it is very likely that glazed structural systems will continue to develop still further. In this study three new structural systems from the many possibilities have been chosen for closer examination. Temperatures inside and outside glass and plastic-based units, some filled with light penetrable insulation materials, were recorded from full-size units under real climatic conditions for half a year. The fumes of some units were made of reinforced plastics, others of aluminium. Based on the literature and some laboratory tests, the design methods and the strength and stiffness properties of adhesive bonds between the glass unit and the aluminium frame have been studied. This building method is already used in some buildings in Finland. The third new building system in this study has been glazed structures without the usual aluminium frames. Based on the literature, the properties of different joint solutions, such as compressed gasket joints, adhesive joints and point connection joint, are considered and their applicability in the Finnish climate evaluated.

3202 Transportation

Refer also to citation(s) 5893, 6474, 7146

5812 (SA-PUB–3/92, pp. 290-293) **Development of person transport in Finland.** Himanen, V. (Technical Research Centre of Finland, Espoo (Finland). Road and Traffic Lab.); Jaervi-Nykaenen, T. Academy of Finland, Helsinki (Finland). 1992. In *The Finnish research programme on climate change: Progress report.* 310p. Order Number DE93752870. Source: OSTI; NTIS.

SILMU Research Programme.

Passenger traffic has been steadily increasing in all developed countries over the last few decades. The growth has been most

obvious in passenger vehicle traffic and air travel. The ongoing development can be examined with reference to three parameters, those of time, speed, and vehicle mileage. If we generalize matters somewhat, it is possible to say that the mean speed of travel and the daily distance covered have increased, while the average time spent each day in travelling has remained at much the same level. Zahavi (1979) brought out the importance of the stable time assigned to daily travel, but as yet this feature has still not been discussed in any detail in traffic studies. Finland can call upon an extremely comprehensive body of material for basic research into this area. The Roads Administration (formerly the RWA) has carried out nationwide passenger traffic surveys in 1974, 1980, and 1986. A fourth such study will be performed during 1992. In addition, three wide-ranging studies have been undertaken on traffic in the Helsinki Metropolitan Area. One direct consequence of the growth in traffic has been increased energy consumption and rising CO_2 emissions. In spite of the considerable attention being paid to environmental issues, there are no signs of an end to the growth in traffic volumes, with the exception of the temporary levelling out brought by the current economic downturn.

3203 Industrial and Agricultural Processes

Refer also to citation(s) 5236, 5237, 5296, 5685, 5788, 5936, 5941, 5942, 6021, 6046, 6211, 6223, 6566, 6659, 6660, 6661, 6664

5813 (ANL/ES/CP–77925) **Chemical and mechanical recycling of shredder fluff.** Jody, B.J.; Daniels, E.J.; Bonsignore, P.V.; Shoemaker, E.L. Argonne National Lab., IL (United States). [1992]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9210244–1: Pollution prevention conference iron and steel industry, Chicago, IL (United States), 14-15 Oct 1992). Order Number DE93004186. Source: OSTI; NTIS; GPO Dep.

Each year, the secondary metals industry recovers about 55–60 million tons of prompt and obsolete scrap which is used in the production of finished steel products. The single largest source of this scrap is the obsolete automobile. The shredder industry recovers about 10–12 million ton/yr of ferrous scrap, most of which is from shredded automobiles. However, for each ton of steel recovered, over 500 lb of fluff are produced. Shredder fluff is comprised of the nonmetallic content of the automobile and other shredded materials, such as refrigerators, dryers, and dishwashers, which are commonly called white goods. The plastics content of shredder fluff is typically about 15–20% by weight and is expected to increase over the next decade due to the significant increase in the use of automotive plastics over the past 10–15 years. At present, shredder fluff is landfilled. The rapidly escalating landfilling cost, along with environmental concerns over the fate of this waste, poses a significant cost and liability to the shredder industry. Research is being carried out to identify and develop recycling technologies that will reduce the volume and the mass of shredder fluff going to landfills and to minimize its cost impact on the recycling of secondary metals. Previous research has focused on exploiting the plastics content of shredder fluff and other hydrocarbons present in fluff for secondary recycling (e.g., production of wood-products substitutes) and for quaternary recycling (e.g., energy generation). Limited work was also conducted on tertiary recycling (e.g., pyrolysis and gasification). Although the previous research has established the technical feasibility of most, if not all, of the alternatives that were examined, none have proven to be cost-effective. This paper describes some research at Argonne National Laboratory (ANL) to develop a process to recycle some of the fluff content, primarily the thermoplastics.

5814 (CONF-9205279–, pp. 213-228) **Application of solar heat in farming.** Schulz, H. (Landesanstalt fuer Landtechnik, Freising-Weihenstephan (Germany)). Ostbayerisches Technologie-Transfer-Institut e.V. (OTTI), Regensburg (Germany). 1992. 304p. (In German). From 2. national symposium on thermal solar energy (TSE); Staffelstein (Germany); 14-15 May 1992. In *Second national symposium 'Thermal solar energy'*. Order Number DE93744460. Source: OSTI; NTIS (US Sales Only).

The application of solar heat stands a good chance in farming due to its high demand for heat to be used in domestic water heating and drying in summer. Since 1976, Landtechnik Weihenstephan has inplemented developments, testings and introductions to practical application of simple and price-effective solutions for the thermal utilization of solar energy. Solutions were developed on a do-it-yourself-base for water and air collectors, storage tanks, heat exchangers and drying systems. A good performer was identified in a simple gravity-type domestic-water heating system with a collector made of black PE or PP tubes, non-pressurized storage tank and a copper pipe coil acting as flow heater. The author reports on different developments. (BWI).

5815 (DOE/ID/12692–2) **Dual cure solventless coating process: Phase 2, Final report.** Minnesota Mining and Mfg. Co., St. Paul, MN (United States). Corporate Research Labs. Oct 1992. 107p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-88ID12692. Order Number DE93001351. Source: OSTI; NTIS; GPO Dep.

The objective of 3M's contract is to develop Dual Cure Photocatalyst technology for the reduction of gaseous waste emissions through the minimization of coating solvent use. This is to be accomplished by developing a photocuring technology that would allow the use of solvent free (100% solids) formulations while preserving or improving upon the performance of conventional solvent based materials. Phase II focused on development of the engineering steps required to transfer this technology from the laboratory to pilot plant scale applications. Preparation of commercially significant quantities of photocatalyst was demonstrated in this phase. Dual cure target Applications were also evaluated. These utilized both urethane/acrylate and epoxy/acrylate compositions. The ability to cure both clearcoat and pigmented compositions in air with visible light under mild conditions has been shown. The cured materials were evaluated for their physical properties and enhanced performance was observed in comparison to the separate components. Significant reduction in volatile organic compound (VOC) emissions has been shown. In selected applications a reduction in VOC from 650 gm/L to less than 100 gm/L may be achieved. The chemistry of catalyst activation was also explored. Cost, economic and energy analyses conducted during Phase I, were updated based on the new information obtained in Phase II.

5816 (DOE/ID/12726–T4) **Advanced moisture sensor research and development: Quarterly progress report, August 1, 1992–October 31, 1992.** De Los Santos, A. Solar Energy Research Inst., Golden, CO (United States). 31 Oct 1992. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC02-88ID12726. Order Number DE93004947. Source: OSTI; NTIS; GPO Dep.

During this period, testing of the system continued at the American Fructose (AF) plant in Dimmitt, Texas. Testing at the first two sites (dryer output and dryer input) was completed. Following the testing at the second site, the sensor was returned to the Southwest Research Institute (SwRI) laboratories for modifications and for fitting of the additional components required to allow sampling of the material to be measured at the third site. These modifications were completed during this reporting period, and the system is scheduled to be installed at the third site (Rotary Vacuum Filter output) early in the next period. Laboratory measurements of corn germ (to be measured at the fourth site) and a variety of fruits and vegetables (one of which will be measured at the fifth site) have also continued during this period.

5817 (DOE/ID/12905–T3) **Development of a field worthy sensor system to monitor gaseous nitrogen transfer from agricultural cropland: Phase 1, Final report.** Georgia Inst. of Tech., Atlanta, GA (United States). Georgia Technology Research Inst. Nov 1992. 46p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC02-89ID12905. Order Number DE93003284. Source: OSTI; NTIS; GPO Dep.

Nitrogen fertilizer accounts for 25 to 33% of the energy requirements in modern crop agriculture in the world today. Energy input for the manufacture of these N fertilizers is in the range of 460 x 10^{12} Btu per year. Unfortunately, for some N sources up to 70% of this energy in the form of NK can be lost through improper application techniques and poor N management strategies. Anhydrous NH_3 may be lost to the atmosphere during and after placement

due to soil conditions placement. Measurement of volatile N is difficult, especially under field conditions. A precise and convenient method of measuring gaseous NH_3 near and above the soil surface is prerequisite to the development and evaluation of alternative fertilizer management strategies and application techniques which can reduce the potential for significant loss. Recent advances in integrated-optic (IO) based sensing offers the potential of measuring low levels of NH_3 loss from a cropping system in the range of 100 ppB. The integrated design of an IO system allows for a more durable device that can be mass produced at low cost. Under Phase I of this project, two IO devices were designed and tested: an absorption device using an oxazine dye as a waveguide coating and an interferometric device using an anilinium salt as a waveguide coating.

5818 (DOE/ID/12917–T1) **Ripeness sensor development: Final report.** Purdue Univ., Lafayette, IN (United States). Dept. of Agricultural Engineering. Nov 1992. 50p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC02-89ID12917. Order Number DE93003283. Source: OSTI; NTIS; GPO Dep.

About 20–25% of the total production of fruits and vegetables in the USA must be discarded after harvest About 25–30% of this loss is the result of over-ripening and this loss represents about 8.39×10^{12} BTU of invested energy every year. This invested energy could be saved by non-destructive ripeness sensing. Sweetness is an important indicator of fruit quality and highly correlated with ripeness in most fruits. Research to develop a non-destructive fruit ripeness sensor has been conducted in the Agricultural Engineering Department at Purdue University. It is based on ^{1}H-MR (proton Magnetic Resonance). A first generation prototype of the ripeness sensor based on ^{1}H-MR was built and tested with. Results show that the sensor can discriminate small fruit (0.75 in diameter or smaller) differing in sugar content by 6%. This prototype can separate the fruit into at least two groups: one ripe and the other not ripe. The estimated cost for such a ripeness sensor is around $4,000. The signal sensitivity of the prototype can be improved to enable it to differentiate between fruits varying in sugar content by only 1 or 2% by using water peak suppression techniques to recover relatively weak sugar resonance signals in intact fruits, modifying circuits to eliminate noise, leakage and distortion of input/output signals, improving the magnetic console to get a higher magnetic field and better homogeneity, and designing a probe to achieve a higher signal-to-noise (S/N) ratio. As research continues a second generation ripeness sensor will be developed which will incorporate many of the improvements and which will be suitable for commercial use. Additional research will allow application of the technique to a wider range of fruit sizes (from blueberries to watermelons). This report describes estimated energy savings, feasibility studies, development of the initial prototype, and preliminary evaluation of the first generation prototype.

5819 (ETDE-mf–93744399) **Energetic coupling of low-temperature waste energy with greenhouse heatings.** Technische Universitaet Chemnitz, Sektion Verarbeitungstechnik. Preprint. Weise, H.; Boehme, G. Technische Univ. Chemnitz (Germany). Sektion 9 - Verarbeitungstechnik. 1991 28p. (In German). Order Number DE93744399. Source: OSTI; NTIS (US Sales Only).

The posed task of meeting the heating energy demand of greenhouses predominantly with cooling water from large technical plants presented requirements based on the economic marginal conditions given, the state of the art analysed, and the factual needs of the energetic coupling to be achieved. The solution is found by redesigning and stabilization of air circulation control and air exchange in the greenhouse. This is solely dependent on the reaction level of the plants. By means of a simple three-zone model of the air space of the greenhouse and the choice of climate parameters to be taken into account, the approach for the required air circulation control in the greenhouse is derived from the graphic representation of the temperature and enthalpy characteristics of the heating process, and indicated as a temperature-and-enthropy relationship. (orig./BWI).

5820 (ETDE-mf–93750622) **Design, construction and operation of a gas-fuelled heating furnace designed to reduce fuel consumption and scaling. Final report.** Beckervordersandforth, C.P.; Fleischer, T.; Klug, K.H.; Kremer, H.; Lueth, E. Gaswaerme-Institut e.V., Essen (Germany); Bundesministerium fuer Forschung und Technologie, Bonn (Germany). 30 May 1990 103p. (In German). Contract BMFT EE212/83;BMFT 03E8510;GWI 8348. Order Number DE93750622. Source: OSTI; NTIS (US Sales Only).

Together with gas companies, furnace engineers and a forging shop, Gaswaerme-Institut developed and tested a gas-fired rapid heating furnace for the low-scale and low-decarburization reheating of billets in a project sponsored by the West German Ministry of Research and Technology and the Commission of the European Communities. Apart from minimum scale formation and low decarburization, minimum energy consumption, low pollutant emission levels, automation and flexibility, for instance, with regard to charge geometry were important criteria. If the furnace is designed appropriately and the design calls, for instance, for a cost/benefit analysis demonstrated that the reheating costs associated with the gas fired rapid heating furnace are only 50% of the reheating costs incurred in induction heating for a wide range of parameters. The demonstration project justifies the conclusion that a gas-fired rapid heating furnace is a highly competitive alternative to an induction furnace. (orig./GL).

5821 (KFK–5087) **Contributions to cleaner chemical waste treatment and production processes.** Schmieder, H.; Bleyl, H.J.; Boukis, N.; Ederer, H.; Galla, U.; Goldacker, H.; Grimm, R.; Henrich, E.; Kluth, M.; Petrich, G.; Schoen, J.; Weirich, F. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Heisse Chemie; Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Schadstoff- und Abfallarme Verfahren (PSA). Sep 1992. 31p. (In German). Order Number DE93744815. Source: OSTI; NTIS (US Sales Only).

Ways and chances for the development of cleaner chemical waste treatment and production processes are discussed. Supercritical fluids as reaction media and as separation solvents and the application of indirect electroredox processes were selected for process developments. The R and D activities are described in detail. (orig.).

5822 (MLM–3766) **Measurement process error determination and control.** Everhart, J. EG and G Mound Applied Technologies, Miamisburg, OH (United States). [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-88DP43495. (CONF-9210218–1: Productivity quality conference, Dayton, OH (United States), 21-23 Oct 1992). Order Number DE93002948. Source: OSTI; NTIS; GPO Dep.

Traditional production processes have required repeated inspection activities to assure product quality. A typical production process follows this pattern: production makes product; production inspects product; Quality Control (QC) inspects product to ensure production inspected properly QC then inspects the product on a different gage to ensure the production gage performance; and QC often inspects on a different day to determine environmental effect. All of these costly inspection activities are due to the lack of confidence in the initial production measurement. The Process Measurement Assurance Program (PMAP) is a method of determining and controlling measurement error in design, development, and production. It is a preventive rather than an appraisal method that determines, improves, and controls the error in the measurement process, including measurement equipment, environment, procedure, and personnel. PMAP expands the concept of the Measurement Assurance Program developed in the 1960's by the National Bureau of Standards (NBS), today known as the National Institute of Standards and Technology (NIST). PMAP acts as a bridge in the gap between the Metrology Laboratory and the production environment by introducing standards (or certified parts) into the production process. These certified control standards are then measured as part of the production process. A control system is present to examine the measurement results of the control standards before, during, and after the manufacturing and measuring of the product. The results of the PMAP control charts determine random uncertainty and systematic (bias from the standard) error of the measurement process. The combinations of these uncertainties determine the margin of error of the measurement process. The total measurement process error is determined by combining the margin of error and the uncertainty in the control standard.

5823 (NEI-DK–1028) **Pressalit Ltd., the model enterprise for efficient utilization of energy: Status mid-1992.** Pressalit A/S, Ry (Denmark). Aug 1992. 48p. (In Danish). Contract ENS-51191-91.0093. Order Number DE93752977. Source: OSTI; NTIS.

Pressalit Ltd., was the company chosen by the (Danish) Committee for Industry and Energy as part of their project for initiating and coordinating efforts to increase efficiency with regard to industrial consumption of energy in relation to the Ministry of Energy's plan of management "Energy 2000". The idea was to test and inform on energy-efficient technologies and methods. Detailed plans aimed at saving on electricity and other forms of energy consumption were constructed and those which were reasonably inexpensive were carried out. Information on the results of these efforts was then disseminated to other companies through visits, articles and pamphlets etc. Pressalit Ltd., established during the year 1954, produces lavatory seats in hard plastic and bathroom equipment for the elderly and the handicapped. About 90% of production is for export. It employs 240 people and the factory covers an area of 9000 m^2. The ventilation in the hall where the plastic materials are pressed and formed was reduced, giving an annual reduction of 25% of electricity consumption here. The temperature of the inlet air was also reduced by 1 degree centigrade giving a further 3% reduction of consumption. A compressor of 35 kW was substituted by one of 0.9 kW, resulting in a reduction of 12% electricity consumption. Lighting was reduced in intensity, here the saving was 24%. Total savings inside the company on electricity consumption reached 13%. All methods and results of efforts aimed at energy conservation are recorded and available to other firms. (AB).

5824 (PNL–8218) **Summary of the government/industry workshop on new materials and processing technologies for industrial applications.** Young, J.K. Pacific Northwest Lab., Richland, WA (United States). Jul 1992. 83p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93004631. Source: OSTI; NTIS; GPO Dep.

This report presents a summary of the 1-day workshop conducted at Ann Arbor, Michigan, on April 16, 1992, between the National Center for Manufacturing Sciences (NCMS) and the US Department of Energy Advanced Industrial Materials Program (DOE AIM). The workshop objectives were to: (1) encourage collaboration between DOE, the DOE national laboratories, and NCMS material manufacturers and (2) assist the DOE AIM program in targeting research and development (R&D) more effectively. During the workshop, participants from industry and DOE laboratories were divided into three working groups. Representatives from the DOE national laboratories currently conducting major research programs for AIM were asked to be working group leaders. The groups developed recommendations for NCMS and AIM managers using a six-step process. As a result of the workshop, the groups identified problems of key concern to NCMS member companies and promising materials and processes to meet industry needs. Overall, the workshop found that the research agenda of DOE AIM should include working with suppliers to develop manufacturing technology. The agenda should not be solely driven by energy considerations, but rather it should be driven by industry needs. The role of DOE should be to ensure that energy-efficient technology is available to meet these needs.

5825 (SAND–92-2430) **Manufacturing technology: A Sandia Technology Bulletin, November 1992.** Leonard, J.A.; Floyd, H.L.; Parrott, L.; Goetsch, B.; Doran, L. (eds.). Sandia National Labs., Albuquerque, NM (United States). 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93004279. Source: OSTI; NTIS; INIS; GPO Dep.

This issue describes several innovative technologies in modern manufacturing. Methods in which the HIRCIS sensor may cut costs in precision machining are described. Computer models and experimental methods aid in the chemical vapor deposition of high-temperature coatings. Shared computer networks provide communication for interactive collaboration. Sol-gel processing of tailored thin films furnish low cost, high quality glass coatings at room temperature. Integrated circuit characterization tools and expertise are available to improve quality and reliability in the microelectronic industry.

5826 (SAND–93-8201) **Process Waste Assessment for the Photography Laboratory.** Phillips, N.M. Sandia National Labs., Livermore, CA (United States). Oct 1992. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DR00789. Order Number DE93004384. Source: OSTI; NTIS; GPO Dep.

This Process Waste Assessment was conducted at the Photography Laboratory to identify waste generating processes with the goal of minimizing hazardous wastes. Since the laboratory did not operate for 14 months, the focus of this PWA was primarily to document new processes, identify waste streams, and serve as a reference for future assessments. The hazardous waste reduction realized from the remodeling were significant and include reducing waste water effluent by 92%, reducing the RA-4 developer chemistry volume by 50 gallons, reducing significant waste and water use through the shutdown of the E-6 processor, and totally eliminating formaldehyde in the C-41 stabilizer chemistry. The staff will be keeping more formal records in the future regarding the chemicals added to each unit and the wastes generated.

5827 (SLU-LT-R–155) **Energy and agriculture: Part 1. House heating from biofuels.** Almquist, A.; Nilsson, Daniel. Swedish Univ. of Agricultural Sciences, Uppsala (Sweden). Dept. of Agricultural Engineering. 1992. 165p. (In Swedish). Order Number DE93753073. Source: OSTI; NTIS.

The report is primarily intended to support courses for undergraduates in agricultural engineering, but is also intended for a wider use among advisers in agriculture and forestry, farmers, house owners etc. The report consists of two sections. The first part considers energy management, energy conservation and estimation of energy and power requirements of buildings. In addition, combustion, furnaces and heat distribution are considered. The second part deals with production and utilization of biofuels, for instance wood, forest residues, salix, straw, energy grass, cereals, biogas and peat. Finally, economic and market aspects are discussed.

5828 (TKK-KO/ET–44) **Droplet size of black liquor spraying.** Paloposki, T.; Kankkunen, A. Helsinki Univ. of Technology, Otaniemi (Finland). Inst. of Energy Engineering. 1991. 73p. (In Finnish). Order Number DE93752935. Source: OSTI; NTIS.

Final report of project LIEKKI 1-9.

The atomization of black liquor with splashplate nozzles was studied experimentally. A black liquor spray rig was built for the experiments. Water, glycerol, and mixtures of water and glycerol were first used in testing of the spray rig. Two different black liquors were used in the experiments, one from softwood pulping and the other from hardwood pulping. The maximum flow rate of the liquor was 1 500 l/h.

5829 (TVA-Bull–Z-297) **TVA's coproduction of electricity and fertilizer project.** Bradshaw, D.T. (Tennessee Valley Authority, Chattanooga, TN (United States)); Wright, T.L.; Faucett, H.L.; Weatherington, R.W. National Fertilizer and Environmental Research Center, Muscle Shoals, AL (United States). [1991]. 25p. Sponsored by Tennessee Valley Authority, Knoxville, TN (United States). (CONF-9110134–2: 10. Electric Power Research Institute (EPRI) coal gasification power plants conference, San Francisco, CA (United States), 16-17 Oct 1991). Order Number DE93002451. Source: OSTI; NTIS.

TVA is proposing to develop and commercially demonstrate the coproduction of electricity and fertilizer using integrated gasification/combined cycle (IGCC) technology. The Coproduction Demonstration Project (CDP) will show that coproduction of chemicals with electricity can economically and environmentally enhance the production of electric power from coal. The proposed CDP will be a nominal 250-M plant. During normal operation, the CDP will produce about 150 MW of base-load capacity and 1000 tons per day (TPD) of urea. Sulfur is recovered either as sulfuric acid or elemental sulfur. During peak power demand, the fertilizer capacity can be bypassed, and the full 250 MW can be produced. Subsequent IGCC/fertilizer coproduction (IGCC/F) plants may convert only 20 to 25 percent of the plant's capacity as fertilizer or other chemicals, depending on optimum IGCC/F operating conditions. The coproduction of electricity and fertilizer allows the continuous operation of the capital intensive gasification-related process units at 100-percent capacity, while varying the amount of electricity

produced from 60 percent to 100 percent of rated capacity. Coproduction also will further reduce the annual revenue requirements for power generation by the coproduction of the higher valued fertilizer coproduct. Since nitrogen fertilizers are produced from natural gas, the real escalation of natural gas prices in the 1990s is expected to result in significant price increases in natural gas-based chemicals, especially fertilizers. The overall risk of producing revenues is reduced because two countercyclic coproducts are produced. Electricity has peak demands in the summer and winter while fertilizer's peak demand is in the spring.

5830 (TVA-Bull–Z-304) **Fertilizer production facilities of the twenty-first century.** Faucett, H.L.; Nichols, D.E.; Weatherington, R.W. National Fertilizer and Environmental Research Center, Muscle Shoals, AL (United States). [1991]. 14p. Sponsored by Tennessee Valley Authority, Knoxville, TN (United States). (CONF-9110445–1: Annual meeting of the fertilizer industry round table, Muscle Shoals, AL (United States), 21-25 Oct 1991). Order Number DE93002589. Source: OSTI; NTIS.

TVA is examining the concept of using integrated gasification combined cycle technology as a way of meeting electrical power and fertilizers needs starting around the year 2000. This technology offers a way to use coal, a US resource, in an environmentally acceptable manner to produce electricity, urea, and sulfuric acid for phosphate fertilizer. The technology, envirorunental emissions, and economics for a commercial-scale production facility are discussed.

5831 (TVA-Bull–Z-322) **Enhancement of broiler litter to improve the fertilizer quality of litter.** Ransom, J.M.; Strickland, R.C. National Fertilizer and Environmental Research Center, Muscle Shoals, AL (United States). [1992]. 6p. Sponsored by Tennessee Valley Authority, Knoxville, TN (United States). (CONF-9210235–1: National poultry waste symposium, Birmingham, AL (United States), Oct 1992). Order Number DE93003912. Source: OSTI; NTIS.

This document presents efforts to utilize poultry litter for feed, fertilizer, and soil amendments. Historical and programmatic efforts by TVA are discussed. Current methods of drying and pelleting the litter, along with more direct methods of composting are reported.

5832 (UCRL–53943-91, pp. 137-140) **Mediated electrochemical oxidation of hazardous and mixed wastes.** Farmer, J.C.; Wang, F.T.; Hickman, R.G.; Hawley-Fedder, R.A.; Lewis, P.R.; Summers, L.J.; Foiles, L. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

In the future, mediated electrochemical oxidation (MEO) may be used to destroy hazardous waste at ambient temperature and to convert mixed waste to low-level radioactive waste. The authors have studied the MEO of ethylene glycol and benzene, determining destruction and current efficiencies. The authors used gas chromatography with mass spectrometry (GC/MS) to identify reaction intermediates and developed a model that accounts for sequential formation of intermediates to predict the time dependence of CO_2 evolution.

5833 (UCRL–53943-91, pp. 141-144) **Molten-salt destruction process for mixed wastes.** Upadhye, R.S.; Cooper, J.F. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

The authors are developing an advanced, two-stage process for treating mixed wastes that contain both hazardous and radioactive components. Pyrolysis and oxidation destroy the organic constituents of the mixed waste. The melt retains heteroatoms, such as chlorine, in the mixed waste and metathesizes them into stable salts, such as NaCl. The melt also retains radioactive actinides.

5834 (VTT-PUB–102) **Thermochemical conversion of black liquor organics into fuels.** Oasmaa, A. (Technical Research Centre of Finland, Espoo (Finland). Lab. of Fuel and Process Technology); Alen, R.; McKeough, P.; Johansson, A. Technical Research Centre of Finland, Espoo (Finland). 1992. 28p. Order Number DE93752851. Source: OSTI; NTIS.

A low viscosity fuel oil has been prepared from black liquor by the following process: (1) thermal treatment of black liquor at 300 - 350 deg C under pressure (20 MPa) in the presence of excess alkali (NaOH), (2) removal of sodium from the black liquor primary oil by acid wash, and (3) catalytic upgrading of the sodium-free black liquor primary oil. The yield of primary oil was about 40 wt% of the initial black liquor organics in the thermal treatment stage. The oil had a sodium content of 7 % (dry matter basis), and only about 1 % of the oil was distillable (< 260 deg C). By washing the oil with dilute acid the sodium content was reduced to 0.02 %. In this case the distillate yield was 11 %. After the catalytic (Ni-Mo/CoMo) two-stage (30 min at 280 deg C and 60 min at 390 deg C) hydrotreatment the oil yield was 88 % and the distillate yield 51 %. The total loss of organics in the wash and upgrading stages was 20 - 25 %.

5835 (VTT-TIED–1332) **Applying MORT maintenance safety analysis in Finnish industry: A handbook.** Ruuhilehto, K. (Technical Research Centre of Finland, Espoo (Finland). Safety Engineering Lab.); Virolainen, K. Technical Research Centre of Finland, Espoo (Finland). 1992. 68p. (In Finnish). Order Number DE93752855. Source: OSTI; NTIS.

Faults or deficiencies in a maintenance planning and managing system weaken the safety and reliability of maintenance work. The safety analysis method presented in this publication is based on the MORT method (Management Oversight and Risk Tree), especially on the version developed for safety considerations in the evaluation of maintenance programs. The MORT maintenance safety analysis is intended especially for the use maintenance safety management. The analysis helps managers evaluate the goals of their safety work and measures taken to reach them. The analysis is done by a team or teams. The teams ought to have expert knowledge of the organization both vertically and horizontally in order to be able to identify factors that may contribute to accidents or other interruptions in the maintenance work. Identification is made by using the MORT maintenance key question set as a check list. The questions check the way safety matters are connected with the maintenance planning and managing, as well as the safety management itself. In the second stage means to eliminate the factors causing problems are developed. New practices are established to improve safety of maintenance planning and managing in the enterprise. This manual includes directions how to use the MORT method in a safety analysis, and the key questions for the check list. The work has been done in cooperation with the United Paper Mills. Ltd. Rauma Paper.

5836 (VTT-TIED–1376) **Sneak analysis applied to process systems.** Whetton, C. (Technical Research Centre of Finland, Espoo (Finland). Safety Engineering Lab.). Technical Research Centre of Finland, Espoo (Finland). 1992. 96p. Order Number DE93752866. Source: OSTI; NTIS.

Traditional safety analyses, such as HAZOP, FMEA, FTA, and MORT, are less than effective at identifying hazards resulting from incorrect 'flow' - whether this be flow of information, actions, electric current, or even the literal flow of process fluids. Sneak Analysis (SA) has existed since the mid nineteen-seventies as a means of identifying such conditions in electric circuits; in which area, it is usually known as Sneak Circuit Analysis (SCA). This paper extends the ideas of Sneak Circuit Analysis to a general method of Sneak Analysis applied to process plant. The methods of SA attempt to capitalise on previous work in the electrical field by first producing a pseudo-electrical analog of the process and then analysing the analog by the existing techniques of SCA, supplemented by some additional rules and clues specific to processes. The SA method is not intended to replace any existing method of safety analysis; instead, it is intended to supplement such techniques as HAZOP and FMEA by providing systematic procedures for the identification of a class of potential problems which are not well covered by any other method.

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Refer also to citation(s) 5236, 5239, 5278, 5677, 5687, 6070

5837 (CRIE-W–0384) **Development of a 100KW class plasma torch for ash-melting plasma furnaces.** Shibuya, M. (Central Research Institute of Electric Power Industry, Tokyo (Japan)); Amakawa, T.; Adachi, K.; Yasui, S.; Iwata, M.; Yamazaki, T.; Kinoshita, K.; Iida, K. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Aug 1991. 18p. (In Japanese). Order Number DE93754079. Source: OSTI; NTIS.

Wastes processing technologies are demanded in recent years for wastes increasing especially in urban areas to be turned harmless, reduced in volume, and reutilized as resources. This paper reports development of a 100 Kw class plasma torch applicable to ash-melting plasma furnaces and summarizes the results of a performance verification test on the torch trially used in a 300 kW class model plasma furnace. The developed torch is of a low-flow nitrogen gas blowing type using compact and solid tungsten electrodes for the reasons of long-term durability and processing expense reduction. The trial use in the model plasma furnace proved assurance in reducing heat loss, NO_x contained in the waste gas, and plasma gas cost, as well as the durability as a result of 100-hour continuous operation. The incineration furnace has a melting capacity of 50 kg/100kw·h, which could be increased up to 100 kg with practical usefulness if an improvement is given to reduce the size. A prospect was obtained that the ash volume could be reduced by (2/3) by melting and solidifying it. The melting point temperature is about 1200°C, though depending on types of ashes. 15 figs., 2 tabs.

5838 (DOE/CE/26603–T2) **District Heating and Cooling Technology Development Program: Phase 2, investigation of reduced-cost heat-actuated desiccant cooling systems for DHC applications: Final report, August 20, 1990–January 1, 1992.** Patch, K.D.; DiBella, F.A.; Becker, F.E. TECOGEN, Inc., Waltham, MA (United States). Feb 1992. 71p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG01-90CE26603. (TR–4504-017-92). Order Number DE93003633. Source: OSTI; NTIS; GPO Dep.

A detailed assessment has been completed of the use of desiccant-based customer-sited heat-actuated cooling for District Heating and Cooling (DHC) systems, showing that introduction of a reduced-cost desiccant cooling system would result in widespread market penetration. This program consisted of three principal components: a market study of existing and future reduced-cost liquid desiccant cooling (LDC) systems; an examination of the installed costs of these existing and reduced-cost LDC systems; and four detailed case studies. Both the installed cost and equivalent chilled water cost of existing large LDC systems were found to be quite competitive with district chilled water, while the high capital cost of small LDC systems made them more expensive than district chilled water. Potential total system sales in this existing large-scale LDC market are quite low, since most of the market for DHC space conditioning is in smaller equipment sizes. Cost savings realized from producing a reduced-cost LDC system would result in small LDC systems (sized well below 6,000 cfm) becoming competitive with the current range of district chilled water costs.

5839 (DOE/CE/27504–3) **Multifamily recycling programs: Program data and implementation guidelines: Multifamily recycling in San Diego, California, and Portland, Oregon.** Urban Consortium for Technology Initiatives (United States). Energy Task Force; Public Technology, Inc., Washington, DC (United States); San Diego Waste Management Dept., CA (United States); Portland Energy Office, OR (United States). Sep 1992. 130p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90CE27504. Order Number DE93005609. Source: OSTI; NTIS; INIS; GPO Dep.

Portland, Oregon, and San Diego, California worked independently, but on similar tracks to implement and study multi-family recycling systems. This report examines the implementation and lessons learned from these programs. Each city adapted the program to fit their local environment. San Diego focussed their outreach on garbage haulers as well as property managers. San Diego worked to promote the participation of the private sector in multifamily recycling and to encourage haulers to duplicate the program with their other multifamily customers. Portland focussed its outreach on the property owners and managers because a new Oregon law requires that landlords provide recycling service and education to all their tenants. The end product in each city was on-site recycling systems and tenant education serving nearly 9,000 multi-family units combined. Newspapers comprised the largest material by volume and weight collected in each city and accounted for the majority of the estimated energy savings in each program. Although recycling is often thought of as being good from an environmental and resource perspective, results from the energy savings analyses show that there is also a considerable energy savings potential from multifamily recycling.

5840 (DOE/CE/27504–10) **Recycling and composting demonstration projects for the Memphis region.** Muller, D. (Memphis and Shelby County Div. of Planning and Development, TN (United States)). Urban Consortium for Technology Initiatives (United States). Energy Task Force; Public Technology, Inc., Washington, DC (United States); Memphis and Shelby County Div. of Planning and Development, TN (United States). May 1992. 214p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90CE27504. Order Number DE93005617. Source: OSTI; NTIS; GPO Dep.

This report documents the development and implementation of the project entitled "Recycling and Composting Demonstration Projects for the Memphis Region." The project was funded by the Energy Task Force of the Urban Consortium for Technology Initiatives. This Project was implemented by the staff of the Special Programs Section of the Memphis and Shelby County Division of Planning and Development. The project began November 1, 1990, and was completed December 31, 1991. The purpose of the project was to evaluate the feasibility of a variety of solid waste disposal alternatives.

5841 (DOE/CE/27504–13-Pt.2) **Solid waste integrated cost analysis model: 1991 project year report: Part 2.** Urban Consortium for Technology Initiatives (United States). Energy Task Force; Public Technology, Inc., Washington, DC (United States); Houston Public Works Dept., TX (United States). [1991]. 102p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90CE27504. Order Number DE93005621. Source: OSTI; NTIS; INIS; GPO Dep.

The purpose of the City of Houston's 1991 Solid Waste Integrated Cost Analysis Model (SWICAM) project was to continue the development of a computerized cost analysis model. This model is to provide solid waste managers with tool to evaluate the dollar cost of real or hypothetical solid waste management choices. Those choices have become complicated by the implementation of Subtitle D of the Resources Conservation and Recovery Act (RCRA) and the EPA's Integrated Approach to managing municipal solid waste;. that is, minimize generation, maximize recycling, reduce volume (incinerate), and then bury (landfill) only the remainder. Implementation of an integrated solid waste management system involving all or some of the options of recycling, waste to energy, composting, and landfilling is extremely complicated. Factors such as hauling distances, markets, and prices for recyclable, costs and benefits of transfer stations, and material recovery facilities must all be considered. A jurisdiction must determine the cost impacts of implementing a number of various possibilities for managing, handling, processing, and disposing of waste. SWICAM employs a single Lotus 123 spreadsheet to enable a jurisdiction to predict or assess the costs of its waste management system. It allows the user to select his own process flow for waste material and to manipulate the model to include as few or as many options as he or she chooses. The model will calculate the estimated cost for those choices selected. The user can then change the model to include or exclude waste stream components, until the mix of choices suits the user. Graphs can be produced as a visual communication aid in presenting the results of the cost analysis. SWICAM also allows future cost projections to be made.

5842 (DOE/ER/75639–1) **Recycling: You are the solution: Final report.** East Tennessee Discovery Center, Knoxville, TN (United States). [1992]. 50p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER75639. Order Number DE93005315. Source: OSTI; NTIS; INIS; GPO Dep.

Americans produce nearly 150 million tons of residential and commercial solid waste each year, or slightly less than 1,400 lb for

each one of us. This document contains various items related to public education: exhibit text, vocabulary, collection sites, classroom and individual activities, puzzles, classroom simulations.

5843 (DOE/IR/05106–2-Vol.2) **Sludge storage lagoon biogas recovery and use: Volume 2.** Muller, D. (Memphis and Shelby County Div. of Planning and Development, TN (United States)); Norville, C. Urban Consortium for Technology Initiatives (United States). Energy Task Force; Public Technology, Inc., Washington, DC (United States); Memphis and Shelby County Div. of Planning and Development, TN (United States). Jul 1991. 69p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-78IR05106. Order Number DE93005622. Source: OSTI; NTIS; GPO Dep.

The City of Memphis has two wastewater treatment plants. The SWTP employs two large anaerobic digestion sludge lagoons as part of the overall sludge treatment system. Although these lagoons are effective in concentrating and digesting sludge, they can generate offensive odors. The SWTP uses aerobic digesters to partially stabilize the sludge and help reduce objectionable odors before it enters the lagoons. The anaerobic digestion of sludge in the lagoons results in the dispersion of a large quantity of biogas into the atmosphere. The City realized that if the lagoons could be covered, the odor problem could be resolved, and at the same, time, biogas could be recovered and utilized as a source of energy. In 1987, the City commissioned ADI International to conduct a feasibility study to evaluate alternative methods of covering the lagoons and recovering and utilizing the biogas. The study recommended that the project be developed in two phases: (1) recovery of the biogas and (2) utilization of the biogas. Phase 1 consists of covering the two lagoons with an insulated membrane to control odor and temperature and collect the biogas. Phase 1 was found to be economically feasible and offered a unique opportunity for the City to save substantial operating costs at the treatment facility. The Memphis biogas recovery project is the only application in the world where a membrane cover has been used on a municipal wastewater sludge lagoon. It is also the largest lagoon cover system in the world.

5844 (DOE/IR/05106–4) **Evaluation program effectiveness of household hazardous waste collection: The Seattle-King County experience.** Urban Consortium for Technology Initiatives (United States). Energy Task Force; Public Technology, Inc., Washington, DC (United States); Seattle City Office for Long-Range Planning, WA (United States). Oct 1991. 83p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-78IR05106. Order Number DE93005625. Source: OSTI; NTIS; GPO Dep.

The Seattle-King County Hazardous Waste Management Plan provides the framework for an intensive effort to keep Household Hazardous and Small Quantity Generator (SQG) wastes from entering the "normal" municipal waste streams. The Plan sets ambitious goals for diverting thousands of tons of hazardous wastes from being thrown, poured or dumped in the municipal waste stream. During the first five years, over $30 millon will be spent for a variety of HHW and SQG programs. The Plan incorporates a wide range of elements, including education, collection, and compliance components. Many of the hazardous waste education and collection programs have been developed in response to the Plan, so their effectiveness is still undetermined. A key component of the Plan is program evaluation. This report provides descriptions of two evaluation methods used to establish baselines for assessing the effectiveness of the Hazardous Waste Management Plan's programs. Focusing on the Plan's household hazardous waste programs, the findings of the baseline evaluations are discussed and conclusions are made. A general population survey, conducted through telephone interviews, was designed to assess changes in knowledge, attitudes, and behaviors of area residents. Characterization of the solid waste stream was used to identify the hazardous constituents contributed to municipal solid waste by households. Monitoring changes in the amount of hazardous materials present in the waste stream was used to indicate whether or not Program strategies are influencing disposal behaviors. Comparing the data gathered by these two evaluation methods provided a unique opportunity to cross-check the findings and validate that change, if any, has occurred. From the comparisons, the report draws a number of conclusions.

5845 (DOE/IR/05106–6) **Household batteries: Evaluation of collection methods.** Seeberger, D.A. Urban Consortium for Technology Initiatives (United States). Energy Task Force; Public Technology, Inc., Washington, DC (United States); Hennepin County Dept. of Environmental Management, Minneapolis, MN (United States). [1992]. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-78IR05106. Order Number DE93005627. Source: OSTI; NTIS; GPO Dep.

While it is difficult to prove that a specific material is causing contamination in a landfill, tests have been conducted at waste-to-energy facilities that indicate that household batteries contribute significant amounts of heavy metals to both air emissions and ash residue. Hennepin County, MN, used a dual approach for developing and implementing a special household battery collection. Alternative collection methods were examined; test collections were conducted. The second phase examined operating and disposal policy issues. This report describes the results of the grant project, moving from a broad examination of the construction and content of batteries, to a description of the pilot collection programs, and ending with a discussion of variables affecting the cost and operation of a comprehensive battery collection program. Three out-of-state companies (PA, NY) were found that accept spent batteries; difficulties in reclaiming household batteries are discussed.

5846 (DOE/IR/05106–T161) **A municipal guide to least cost utility planning.** Urban Consortium for Technology Initiatives (United States). Energy Task Force; Public Technology, Inc., Washington, DC (United States); Chicago Dept. of Environment, IL (United States). Mar 1992. 119p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-78IR05106. Order Number DE93005624. Source: OSTI; NTIS; INIS; GPO Dep.

The recent track record of "traditional" electricity planning, which entails selection of supply side resources to meet forecasted demand, has not been good. There are numerous examples of utilities incorrectly forecasting demand and over-building generating capacity while others underestimated growth and have had to cut demand and find alternate power sources to avoid outages. A potential solution to this problem is the continuing development of Least Cost Utility Plannning (LCUP). Regulatory commissions, consumer advocates and utilities are increasingly relying an LCUP as the most responsible way to avoid construction of new capacity and alleviate anticipated shortages caused by cancellation of construction projects, load growth, or natural replacement of aging capacity. The purpose of this report is to provide municipalities a starting point for evaluating their servicing utilities or states' least cost plan. This was accomplished by: Identifying key issues in LCUP; reviewing examples of the collaborative and classic approaches to LCUP in Illinois, California, New York State and Michigan; cataloging municipal authorities and strategies which can influence or support LCUP activities. Results of the project indicate that through a basic understanding of LCUP processes and issues, municipalities will be in a better position to influence plans or, if necessary, intervene in regulatory proceedings where plans are adopted. Constraints to municipal involvement in LCUP include statutory limitations, resource constraints, and a lack of knowledge of indirect authorities that support the LCUP process.

5847 (DTH-IMSOR-RR–1991-2) **On-line estimation of time-varying delays in district heating systems.** Soegaard, H.T.; Madsen, H. Technical Univ. of Denmark, Lyngby (Denmark). Inst. of Mathematical and Operations Research. May 1991. 21p. (CONF-9106417–: ESM'91: European simulation multiconference, Copenhagen (Denmark), 17-19 Jun 1991). Order Number DE93752970. Source: OSTI; NTIS.

For simulation and control of a district heating system it is of interest to build a mathematical model of the distribution network. This paper deals with stochastic models of the time-variation of temperatures in distribution networks. Due to variations of the water flow in the distribution network it is not possible to apply traditional modeling techniques assuming a constant time-delay between temperature signals. Two methods for tracking both the delay and the dynamics of an input-output system are presented. The methods are based on recursive estimation of the parameters of ARMAX

models. In the first method simultaneous recursive estimation of the parameters of a number of ARMAX models with different delays is performed. The second method tracks the states - amongst these the delay - of a state space model formulation. The performance of the estimation methods is illustrated on data from a district heating system. It appears that the performance of the estimation methods depends strongly on the dynamical characteristics of the variations of the delay. The best results are achieved for slowly varying delays. As both methods are based on adaptive schemes they are well suited for on-line applications. Furthermore, the generality of the methods make them applicable to a wide class dynamic systems which contains time-varying delays. (au).

5848 (DTH-IMSOR-RR–1991-21) **Predictor-based optimal control of supply temperature in district heating systems.** Palsson, O.P.; Madsen, H.; Soegaard, H.T. Technical Univ. of Denmark, Lyngby (Denmark). Inst. of Mathematical and Operations Research. Dec 1991. 18p. Contract ENS-1323/89-14. (CONF-920312–1: International IFAC symposium on control of power plants and power systems, Munich (Germany), 9-11 Mar 1992). Order Number DE93752969. Source: OSTI; NTIS.
EFP-89.

A modified version of the linear quadratic Gaussian controller is presented, which is built upon the prediction form of the model. This implies that the controller is more capable of handling non-stationarities, like time-varying model parameters, than the classical type of linear quadratic Gaussian controller, which usually is based on the solution of the Diophantine or the Riccati Equation (in the state-space case). The linear quadratic Gaussian controller is used in a simulation study together with a transfer function model, with time-varying parameters, that describes the relations between supply temperature of the water from a district heating plant and the supply temperature at specific locations in the distribution network. The simulation results show that the variance of the differenced control signal can be reduced drastically without affecting the performance of the controller significantly. (au) (11 refs.).

5849 (NEI-DK–999) **The center for green technology: Suggested project.** Nordvestjysk Folkecenter for Vedvarende Energi, Hurup (Denmark). 1990 15p. (In Danish). Order Number DE93752814. Source: OSTI; NTIS.

The Center for Green Technology is a center for research and development related to "ecological" buildings, food production and waste management which is being developed at the Danish Center for Renewable Energy. One of its aims is to create a village which is independent of outside energy supply, which lives up to the ideals of an environment in balance with nature and where research in green technology can be carried out. It is hoped that this village will act as an example of a way of living which makes every effort to protect the environment. The "Solar Bioshelter" will be constructed to include a combination of offices, laboratories and a greenhouse. Each of these buildings are described in detail and the text is illustrated with diagrams. (AB).

5850 (NEI-DK–1000) **Nordic design competition for novel solutions in low-energy building.** Nordvestjysk Folkecenter for Vedvarende Energi, Hurup (Denmark). [1992] 9p. (In Danish). Order Number DE93752813. Source: OSTI; NTIS.

The overall plan for a community of buildings comprising an integrated housing and business facility with service functions such as accomodation for young people, guest rooms and child care areas is presented. Buildings make use of direct gain of solar energy, with the use of a double glass ceiling constructed as a bead wall with shading and insulating properties, - and containing a large number of indoor plants which play a central part in the functioning of the general heating system. The remaining grounds are given over to gardens and grazing areas for domestic animals. The intention is that this community, which will not be dependent on outside energy resources but will use its own renewable ones, should serve as an example of a village in harmony with nature and contributing almost nothing to environmental pollution. The program itself, the arrangements for energy and insulation, the sewage system, and detailed plans of the buildings are described. Prices are also given. (AB).

5851 (NEI-DK–1008) **Models and methods for optimization of district heating systems. Part 2: Models and control methods.** Energiministeriets Energiforskningsprogram. Fjernvarme og produktion af el og varme. Madsen, H.; Palsson, O.P.; Sejling, K.; Tangen Soegaard, H. Technical Univ. of Denmark, Lyngby (Denmark). Inst. of Mathematical and Operations Research. Aug 1992. 206p. (In Danish). Contract ENS-1323/89-14. Order Number DE93752820. Source: OSTI; NTIS.
EFP-89.

The second part of the main documentation for a larger project having the purpose of developing and testing models and methods which could lead to improved control and supervision of district heating systems. Special emphasis is laid upon the use of the established methods for prediction and control. Some recently established nonlinear models for loads are described in addition to the basic theoretical and statistical approaches. Various methods are analyzed by simulation alone, some are implemented in a software tool (PRESS: PRognose- og EnergiStyrings-System = Prognosis and Energy Control System) for improved control and supervision. The use of these systems, it is claimed, will lead to considerable energy savings, on average a temperature saving of 9 degrees centigrade. A specific district heating system in Varde and Esbjerg (Denmark) is described, and also the intermediate take-out condensing units at Veskraft power station. It is explained how j-step predictions of heat load can be obtained by using the formulated models. The subject of development of controllers for optimization of district heating systems is discussed in detail. Here, minimum variance controllers and its modifications, alternative Linear Quadratic Gaussian, and multi-step controllers are dealt with. These controllers are able to adapt to changes in dynamical characteristics of the system and can be easily installed at new loctions. The computer programme PRESS and the temperature savings obtained are also described. (AB) (32 refs.).

5852 (NUTEK-FJV–92-2) **Direct laying method for district heating pipelines.** Fallsvik, J. (Swedish Geotechnical Inst., Linkoeping (Sweden)); Lindmark, A.; Petersson, E. Swedish National Board for Industrial and Technical Development (NUTEK), Stockholm (Sweden); Statens Geotekniska Inst., Linkoeping (Sweden). Jun 1992. 53p. (In Swedish). Project NUTEK-654-016. (SGI-VARIA–371;SVF–445). Order Number DE93753018. Source: OSTI; NTIS.

The purpose of the project has been to find out what material properties of the heating pipes that govern or influence the ploughing as well as to elucidate the technique requirements in respect of ploughing equipment and project planning methods. Furthermore a preparation and a realization of a practical test has been carried out within the scope of the project. The cost of the direct laying technique can in ploughable soils be reduced to 80-200 SEK/m, which means a total cost of 160-400 SEK/conduit metre depending on the type of soil.

3209 Education and Public Relations

Refer also to citation(s) 5842

5853 (CONF-9101154–, pp. 243-247) **The Munich Bauzentrum (Construction Centre Exhibition).** Schoen, R.L. (Bauzentrum Muenchen (Germany)). Bayerisches Staatsministerium fuer Wirtschaft und Verkehr, Muenchen (Germany). 1991. 306p. (In German). From Symposium on incentives for using renewable energy sources in Bavaria; Coburg (Germany); 28-29 Jan 1991. In *Incentives for using renewable energy sources in Bavaria. Symposium for users and suppliers (local authorities, public utilities, industry, medium enterprises).* Order Number DE93744689. Source: OSTI; NTIS (US Sales Only).

The Munich Bauzentrum was instituted by the Munich Messe und Ausstellungsgesellschaft which focusses on consultancy and information in the Munich region. It is a profit-making body and focusses its activities on a standing exhibition of buildings/family houses, consultant service, oral presentations and seminars and sales of pertinent literature. The author reports on the activities of the Bauzentrum. (BWI).

5854 (CONF-9101154–, pp. 248-251) **The information centre for energy economizing and utilization of renewable energies in the Lindau Landkreis/Lake Constance.** Henninger, K.

Bayerisches Staatsministerium fuer Wirtschaft und Verkehr, Muenchen (Germany). 1991. 306p. (In German). From Symposium on incentives for using renewable energy sources in Bavaria; Coburg (Germany); 28-29 Jan 1991. In *Incentives for using renewable energy sources in Bavaria. Symposium for users and suppliers (local authorities, public utilities, industry, medium enterprises).* Order Number DE93744689. Source: OSTI; NTIS (US Sales Only).

By way of the 'Information Centre for Energy Economizing and utilization of renewable energies the Lindau Landkreis intends to arouse the citizen's interest in the abovementioned fields. This involves a growing number of exhibitions of pertinent technological developments, individual consultancy and oral presentations. The author reports on the activities of the information centre. (BWI).

5855 (CONF-9101154–, pp. 252-263) **SOLID - Solar Information and Demonstration Centre.** Oelmayer, R. (LGA, Nuernberg (Germany)). Bayerisches Staatsministerium fuer Wirtschaft und Verkehr, Muenchen (Germany). 1991. 306p. (In German). From Symposium on incentives for using renewable energy sources in Bavaria; Coburg (Germany); 28-29 Jan 1991. In *Incentives for using renewable energy sources in Bavaria. Symposium for users and suppliers (local authorities, public utilities, industry, medium enterprises).* Order Number DE93744689. Source: OSTI; NTIS (US Sales Only).

On the initiative of BStMWV, the planning stage of an exhibition and consultancy centre for renewable energies was started for the Central Frankonian area. By now SOLID (Solar information and demonstration centre) is close to its opening. The objective of SOLID is to inform consumers about renewable energy carriers, their current and future applications and to promote the use of solar energy, especially that of photovoltaics on a large scale. Major target groups are power utilities, authories, semiconductor companies, trade and crafts and, primarily, the ordinary consumer. (BWI).

5856 (CONF-9205279–, pp. 241-248) **Energy-awareness in building schemes as a perspective for municipal housing development.** Heide, R. Ostbayerisches Technologie-Transfer-Institut e.V. (OTTI), Regensburg (Germany). 1992. 304p. (In German). From 2. national symposium on thermal solar energy (TSE); Staffelstein (Germany); 14-15 May 1992. In *Second national symposium 'Thermal solar energy'.* Order Number DE93744460. Source: OSTI; NTIS (US Sales Only).

The construction of buildings showing awareness of the needs of energy conservation and pollution control is often obstructed by politically mismatched framework conditions today. Even local impulses cannot help much to change this situation. Nevertheless, local authorities can give vital impulses to promote the interest of potential builders in environment-responsive building. In addition, the pressure exerted by local authorities against contraproductive framework conditions and deficits in political implementation needs to be enhanced much more. The planning and construction of new buildings within town planning is one field for an environment-responsive identification of future goals for local governments both to set an example and to promote public awareness. (BWI).

5857 (DOE/ER/75645–1) **Burst of Energy: Final report.** Discovery Center of Idaho, Boise, ID (United States). [1992]. 66p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER75645. Order Number DE93005058. Source: OSTI; NTIS; GPO Dep.

The Discovery Center of Idaho (DCI) was the recipient of a grant from US DOE's Museum Science Education Program to build six permanent energy related exhibits to provide the public with hands-on experience with energy issues. Because of its volunteer support system, DC was able to build eleven exhibits. These exhibits are described and photographs are included. The signs used for the exhibits are reproduced as well as the materials used to advertise them to the public. Examples of DCI's newsletter are included that mention the new exhibits.

5858 (HY/SPL-E–4/1991) **Research unit Energy and Consumers: Progress report.** Arvola, A.; Uutela, A. (eds.). Helsinki Univ. (Finland). Dept. of Social Psychology. 1991. 77p. (In Finnish). Order Number DE93711150. Source: OSTI; NTIS.

The research unit 'Energy and Consumers' is coordinated by the Department of Social Psychology at the University of Helsinki and financed by the Ministry of Trade and Industry for three years (1990-92). The objective of the research unit is to compile and analyze information about the relationships between energy and society, aiming to advance the conservation of energy and the sensible use of energy. The energy research unit consists of six independent projects which are directed by the executive committee set up by the Ministry of Trade and Industry. The aim of the first study is to develop a sociological model concerning the formation of knowledge and attitudes about energy. Attitudes about energy presented in the mass media as well as opinions of experts and individuals are included in the study. The aim of the second study is to analyze the Finnish food distribution system, and the role of the consumer as a part of the distribution system chain, in terms of energy requirements. Special attention is payed to the spatial features of the system. The goal of the third study is to describe private individuals experimenting with energy production and conservation, their activities, motives and opinions. Typically they use solar energy or ground heat for space heating or produce electricity using windmills. The relationship of energy consumption to the everyday life of residents in detached houses is examined in the fourth study. The study attempts to investigate the meaning of activities involving energy consumption, the perception of energy consumption and the perceived obstacles in energy conservation.

33 ADVANCED PROPULSION SYSTEMS

3301 Internal Combustion Engines

Refer also to citation(s) 5895, 5897, 6004, 6142

5859 (CONF-9203140–4) **Computational and experimental study of a railplug ignitor.** Ellzey, J.L. (Texas Univ., Austin, TX (United States). Dept. of Mechanical Engineering); Hall, M.J.; Zhao, X.; Tajima, H. Texas Univ., Austin, TX (United States). Dept. of Mechanical Engineering. [1992]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-91ER12115. From 1992 Spring meeting of the Western States Section of the Combustion Institute; Corvallis, OR (United States); 23-24 Mar 1992. Order Number DE93003101. Source: OSTI; NTIS; GPO Dep.

The plasma plume generated by a new type of high energy Janitor known as the railplug, is examined. The railplug is a miniaturized railgun that has the potential for improving ignition characteristics of combustible mixtures in engines. The objective of the study is to gain an uderstanding of the characteristics of the plasma created by a transparent railplug, and to validate a multidimensional computer simulation of the plasma and shock fronts. The nature of the plume emitted by the railplug was examined for three levels of electrical energy while firing into air at a pressure of 1 atm. The computer model is to be used to predict trends in railplug performance for various railplug designs, energies, and ambient conditions. The velocity of the plasma movement inside a transparent railplug was measured, as well as the velocity of the plume ejected from the cavity. A shock is produced at the initiation point of the arc and propagates down the cavity, eventually exiting the plug. The velocity of the shock was both measured experimentally and simulated by the model. The computer simulation produces a mushroom-shaped plasma plume at the railplug exit similar to that observed in the shadowgraph photos: The simulation also reproduced the toroidal circulation observed at the plug exit in the shadowgraphs, the radial expansion and the penetration depth of the plume. The trend of linearly increasing plasma kinetic energy with stored electrical energy predicted by the simulation was verified by shadowgraph photos. The agreement between the experiments and the simulations suggests that the multidimensional model holds promise is a predictive design tool.

5860 (DOE/MC/24257–3153) **Integrated low emissions cleanup system for direct coal fueled turbines (moving bed, fluid bed contactor/ceramic filter): Eighteenth quarterly status report, January–March 1992.** Newby, R.A.; Alvin, M.A.; Bachovchin, D.M.; Yang, W.C.; Smeltzer, E.E.; Lippert, T.E. Westinghouse Electric Corp., Pittsburgh, PA (United States). Science and Technology Center. 20 Apr 1992. 28p. Sponsored by USDOE,

Washington, DC (United States). DOE Contract AC21-87MC24257. Order Number DE93002680. Source: OSTI; NTIS; GPO Dep.

The United States Department of Energy, Morgantown Energy Research Center (DOE/METC), is sponsoring the development of direct coal-fired turbine power plants as part of their Heat Engines program. A major technical challenge remaining for the development of the direct coal-fired turbine is high-temperature combustion gas cleaning to meet environmental standards for sulfur oxides and particulate emissions, as well as to provide acceptable turbine life. The Westinghouse Electric Corporation, Science & Technology Center, is evaluating two Integrated Low Emissions Cleanup (ILEC) concepts that have been configured to meet this technical challenge: a baseline ceramic barrier filter nEC concept, and a fluidized bed ILEC concept. These ILEC concepts simultaneously control sulfur, particulate, and alkali contaminants in the high-pressure combustion gases at turbine inlet temperatures up to 2300°F. This document reports the status of a program in the eighteenth quarter to develop this ILEC technology for direct coal-fired turbine power plants.

5861 (DOE/MC/26052–3140) **Advanced turbine design for coal-fueled engines: Topical report, Task 1.6, Task 1.7.** Bornstein, N.S. United Technologies Corp., East Hartford, CT (United States). Research Center. 17 Jul 1992. 29p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-89MC26052. Order Number DE93000224. Source: OSTI; NTIS; GPO Dep.

The objective of this task is to perform a technical assessment of turbine blading for advanced second generation PFBC conditions, identify specific problems/issues, and recommend an approach for solving any problems identified. A literature search was conducted, problems associated with hot corrosion defined and limited experiments performed. Sulfidation corrosion occurs in industrial, marine and aircraft gas turbine engines and is due to the presence of condensed alkali (sodium) sulfates. The principle source of the alkali in industrial, marine and aircraft gas turbine engines is sea salt crystals. The principle source of the sulfur is not the liquid fuels, but the same ocean born crystals. Moreover deposition of the corrosive salt occurs primarily by a non-equilibrium process. Sodium will be present in the cleaned combusted gases that enter the PFBC turbine. Although equilibrium condensation is not favored, deposition via impaction is probable. Marine gas turbines operate in sodium chloride rich environments without experiencing the accelerated attack noted in coal fired boilers where condensed chlorides contact metallic surfaces. The sulfates of calcium and magnesium are the products of the reactions used to control sulfur. Based upon industrial gas turbine experience and laboratory tests, calcium and magnesium sulfates are, at temperatures up to 1500°F (815°C), relatively innocuous salts. In this study it is found that at 1650°F (900°C) and above, calcium sulfate becomes an aggressive corrodent.

5862 (DOE/METC/C–93/7042) **Overview of Advanced Turbine Systems Program.** Webb, H.A.; Bajura, R.A. USDOE Morgantown Energy Technology Center, WV (United States). [1992]. 12p. Sponsored by USDOE, Washington, DC (United States). (CONF-921034–2: US Department of Energy contractors review meeting on coal-fueled heat engines, advanced PFBC and gas stream cleanup systems, Morgantown, WV (United States), 27-28 Oct 1992). Order Number DE93003193. Source: OSTI; NTIS; GPO Dep.

The US Department of Energy initiated a program to develop advanced gas turbine systems to serve both central power and industrial power generation markets. The Advanced Turbine Systems Program win lead to commercial offerings by the private sector by 2002. ATS will be developed to fire natural gas but will be adaptable to coal and biomass firing. The systems will be: Highly efficient (15 Percent improvement over today's best systems); Environmentally superior (10 percent reduction in nitrogen oxides over today's best systems); Cost competitive (10 percent reduction in cost of electricity). The ATS Program has five elements: Innovative Cycle Development will lead to the demonstration of systems with advanced gas turbine cycles using current gas turbine technology. High-Temperature Development will lead to the increased firing temperatures needed to achieve ATS Program efficiency goals. Ceramic Component Development/Demonstration will expand the current DOE/CE program to demonstrate industrial-scale turbines with ceramic components. Technology Base will support the overall program by conducting research and development (R&D) on generic technology issues. Coal Application studies will adapt technology developed in the ATS Program to coal-fired systems being developed in other DOE programs.

5863 (DOE/NASA/0335–4) **Advanced Turbine Technology Applications Project (ATTAP): 1991 annual report.** National Aeronautics and Space Administration, Cleveland, OH (United States). Lewis Research Center; Allied-Signal Aerospace Co., Phoenix, AZ (United States). Garrett Auxiliary Power Div. Jun 1992. 142p. Sponsored by USDOE, Washington, DC (United States); National Aeronautics and Space Administration, Washington, DC (United States). DOE Contract AI01-85CE50111. Contract DEN3-335. (NASA/CR–189228;GARRETT–31-8071(04)). Order Number DE93004126. Source: OSTI; NTIS; GPO Dep.

This report summarizes work performed by Garrett Auxiliary Power Division (GAPD), a unit of Allied-Signal Aerospace Company, during calendar year 1991, toward development and demonstration of structural ceramic technology for automotive gas turbine engines. This work was performed for the Department of Energy (DOE) under National Aeronautics and Space Administration (NASA) Contract DEN3-335, Advanced Turbine Technology Applications Project (ATTAP). GAPD is utilizing the AGT101 regenerated gas turbine engine developed under the previous DOE/NASA Advanced Gas Turbine (AGT) program as the ATTAP test bed for ceramic engine technology demonstration. ATTAP is focussing on improving AGT101 test bed reliability, development of ceramic design methodologies, improvement of fabrication and materials processing technology by domestic US ceramics fabricators. Improved combustion system and regenerator technology, and demonstration of technology advancements will be verified in a series of durability tests. This is the fourth in a series of technical summary reports published annually over the course of the five-year contract.

5864 (ETDE/JP-mf–93753796) **Problems on numerical analysis relating to gas turbines.: Basis and application examples.** Gas Turbine Society of Japan, Tokyo (Japan). 31 Mar 1992 171p. (In Japanese). Order Number DE93753796. Source: OSTI; NTIS.

As the beginning of CFD (Computational Fluid Dynamics) technology, the streamline curvature method has been used for design and analysis of the whole system of turbines and compressors. On the contrary, in the cascade flow analysis method, used is the inviscid cascade analysis based on potentials or Eulerian equations, which is in a stage of adolescence. The recent three-dimensional viscos flow field analysis including turbulent flow, heat transfer and chemical reaction is in a stage of transfering to maturity. This analysis seems to be a numerical simulation system including flow, heat transfer, chemical reaction and structure strength in the future. In order to construct the design system by the numerical simulation technology, it is necessary for the simulation technology to be improved in stability, accuracy and calculation efficiency, to be established in reliability and to be validated through high-accurate experiments. The paper presents basic problems, application examples, problems to be pointed out and future issues of CFD technology and also refers to periphery related technology indispensable to development of CFD and subjects and prospect for commercialization. 177 refs., 275 figs., 15 tabs.

5865 (ETDE/JP-mf–93753796, pp. 1-4) **Fundamental problems in gas turbine related numerical fluid dynamics.: Basic equation and boundary condition.** Daiguji, H. (Tohoku University, Sendai (Japan)). Gas Turbine Society of Japan, Tokyo (Japan). 31 Mar 1992. 171p. (In Japanese). In *Problems on numerical analysis relating to gas turbines.: Basis and application examples.* Order Number DE93753796. Source: OSTI; NTIS (US Sales Only).

This paper gives an explanation on the basic equation and the boundary condition in gas turbine related numerical fluid dynamics. Compressive Eulerian equation and Navier-Stokes equation are considered. The basic equation for compressive flow consists of a preservation equation for masses, momentum, and energies. A coordinate conversion that uses a general curve coordinate system ξ is given on the basic equation using the Cartesian coordinate

system$_\chi$. Preservation of momentum in velocity in the$_\chi$space can be described by the ξ space. An equation was also introduced that describes preservation of the momentum in contravariant velocity which is a flow velocity of the ξspace. The basic equation was integrated over a small grid cell region to introduce a basic equation for the finite volume method. The required number of boundary conditions is determined from the theory of characteristics. According to the one-dimensional characteristics theory, systems of hyperbolic partial differential equation can be substituted by the systems of ordinary differential equations composed of the same number of formulas. Each ordinary differential equation expresses waves that propagate along the characteristics. Three-dimensional flow problems are first broken down into one-dimensional problems using an approximation factor process, and then applied with the one-dimensional theory of the characteristics. The paper also explains handling of fixed wall boundary conditions and cyclic boundary conditions. 1 tab.

5866 (ETDE/JP-mf–93753796, pp. 5-20) **Fundamental problems in gas turbines related numerical fluid dynamics.: Numerical solution methods.** Daiguji, H. (Tohoku University, Sendai (Japan)). Gas Turbine Society of Japan, Tokyo (Japan). 31 Mar 1992. 171p. (In Japanese). In *Problems on numerical analysis relating to gas turbines.: Basis and application examples.* Order Number DE93753796. Source: OSTI; NTIS (US Sales Only).

This paper gives an explanation on the numerical solution methods in gas turbine related numerical fluid dynamics. Numerical schemes for compressive flows have shown remarkable advance. Particularly, the flux separation method and the total variation diminishing (TVD) monotonous scheme can capture clearly and stably discontinuities including shock waves. The flux separation method makes the conventional upstream-centering that follows the code of flows more rational to that according to the code of phase velocities of waves propagating along each characteristic based on the theory of characteristics. Viscosity effect is weak in a compressive high-velocity flow, of which Navier-Stokes equation can be solved by solving the hyperbolic equation as an Eulerian equation added with a diffusion term. The Eulerian equation is broken down into one-dimensional problems using an approximation factor method, and can be reduced to the system of ordinary differential equations for three waves that propagate along two waves and a pathline according to the theory of characteristics. In using the TVD monotonous scheme, artificial viscosity or dissipation should not be added indiscriminately to stabilize the solution, but the artificial viscosity is added only where it is required in an only amount required while watching conditions of the solution for total variation diminishing. This paper touches upon also on detail of the numerical solutions. 25 refs., 10 figs.

5867 (ETDE/JP-mf–93753796, pp. 21-29) **Fundamental problems in gas turbine related numerical fluid dynamics.: Calculation meshes.** Inoue, K. (National Aerospace Laboratory, Tokyo (Japan)). Gas Turbine Society of Japan, Tokyo (Japan). 31 Mar 1992. 171p. (In Japanese). In *Problems on numerical analysis relating to gas turbines.: Basis and application examples.* Order Number DE93753796. Source: OSTI; NTIS (US Sales Only).

This paper gives an explanation on the calculation meshes in gas turbine related numerical fluid dynamics. The importance is how to make good meshes efficiently, whereas the differential method uses structural meshes with high regularity while the finite element method uses non-structural meshes requiring no regularity. Three-dimensional meshes for cascade flows use two-dimensional meshes superposed in the span direction. The two-dimensional meshes include O, H and C types. Accuracy of a calculation result depends upon resolution of the meshes Attempts to increase simply the number of mesh points are restricted by computer capacity and calculation time, for which a variety of contrivances have been made. Grid preparation is easier when the calculation regions are divided into regions close to an object and remaining regions, where the regions close to the object are solved using the differential method, and regions linking these differential method regions are solved using the finite element method. It is difficult to cover an object with a complex shape using single meshes , where a method may be used that a plurality of overlapped meshes are prepared and the calculation regions are superposed. Automation of the process has been desired to save labor to prepare meshes. A program is available to produce meshes automatically in the H-type mesh by imaging one cycle flow in a flow region onto a rectangular parallelopiped computation space. The paper also describes other methods. 22 refs., 34 figs.

5868 (ETDE/JP-mf–93753796, pp. 30-40) **Fundamental problems in gas turbine related numerical fluid dynamics.: Turbulence models.** Arakawa, C. (The University of Tokyo, Tokyo (Japan)). Gas Turbine Society of Japan, Tokyo (Japan). 31 Mar 1992. 171p. (In Japanese). In *Problems on numerical analysis relating to gas turbines.: Basis and application examples.* Order Number DE93753796. Source: OSTI; NTIS (US Sales Only).

This paper gives an explanation on the turbulence models in gas turbine related numerical fluid dynamics. Even currently available computers can not perform strict numerical analyses of Navier-Stokes equations, and turbulence models must be introduced. In a mixing distance model, the model is formulated using as a mixing distance a length scale in which momenta are exchanged actively according to vortex movements. In a single equation model, a transportation equation for the turbulent motion energy "κ" is derived from a time averaged Navier-Stokes equation, and combined with a length scale to give vortex viscosity. A bi-equation model is referred also to as a κ-ϵ model, in which a dissipation rate ϵ for turbulent energy is defined using κ as a turbulent energy and ι as a length scale, and the equation is given from a Navier-Stokes equation. The ϵ equation is introduced in the similar manner. In a stress equation model, a Reynolds stress according to a turbulence is derived directly from the transportation equation without hypothesizing a vortex viscosity. In a large eddy simulation (LES), a spatial averaging operation is carried out to separate the flow field into components that can be resolved by grids and components smaller than them. The former components are calculated directly, while the latter components are given some form of modelling. 22 refs., 6 figs.

5869 (ETDE/JP-mf–93753796, pp. 41-42) **Fundamental problems in gas turbine related numerical fluid dynamics.: Reaction models.** Fuji, H. (Ishikawajima-Harima Heavy Industries, Co. Ltd., Tokyo (Japan)). Gas Turbine Society of Japan, Tokyo (Japan). 31 Mar 1992. 171p. (In Japanese). In *Problems on numerical analysis relating to gas turbines.: Basis and application examples.* Order Number DE93753796. Source: OSTI; NTIS (US Sales Only).

This paper gives an explanation on the reaction models in gas turbine related numerical fluid dynamics. The interior of a gas turbine combustor is a turbulent field with turbulent flows and reactions interfering with each other, where calculating reaction velocities in a strict manner is difficult, thus reaction models are necessary. A model that disregards non-homogeneous mixing due to the turbulent flows at infinite reaction velocity is similar to the frame seat model in layer flows. The model has fast reaction velocities and can be applied to mixing rate controlling diffusion flames. A model that considers non-homogeneous mixing can be applied to mixing rate controlling diffusion flames that take incomplete mixing into account, and is closer to reality than the frame seat model. A model that disregards non-homogeneous mixing at finite reaction velocity is chemical reaction velocity controlling. In a model in which a vortex dissipating rate controls the reaction velocity, a combustion reaction takes place when fuel lumps and oxygen lumps collapse and reach a molecular scale mixing. The reaction velocity is in proportion with a collapsing rate of turbulent vortex, and the collapsing rate of this vortex is in proportion with a decay velocity of turbulent energy. 5 refs.

5870 (ETDE/JP-mf–93753796, pp. 43-47) **Applications of gas turbine related numerical analyses and their problems.: Aerodynamic analysis of compressor cascades.** Kodama, H. (Ishikawajima-Harima Heavy Industries, Co. Ltd., Tokyo (Japan)). Gas Turbine Society of Japan, Tokyo (Japan). 31 Mar 1992. 171p. (In Japanese). In *Problems on numerical analysis relating to gas turbines.: Basis and application examples.* Order Number DE93753796. Source: OSTI; NTIS (US Sales Only).

This paper describes numerical analyses for aerodynamic designs of compressors and rotating cascades in turbines. Pressure loss and outlet flow angles are estimated from blade shapes in

each cascade, and the performance of a whole system is determined from calculating flow fields through each cascade. If the performance does not meet the requirement, the cascade shapes are changed, and calculations are repeated on a trial and error basis until the requirement is met. Numerically analytic calculations have become capable of making estimations that have been done by experiments previously, but cannot be depended upon entirely because of their problems in reliability. Increased number of cascades and the aerodynamic performance requirements not only in design points but expanded to a wide range of operation regions have pushed up the amount of iterative calculation works for blade shape determination to a huge amount. Outputting the results quickly is demanded, which inevitably relates to a calculation cost. The paper describes also inter-blade viscosity analyses, and practical applications of inter-blade analyses for flows accompanying shock waves. Problems requiring early solutions include improving the accuracy in estimating binary flows and blade-tip clearance flows by using three-dimensional viscosity analyses, and estimating interference between boundary layers and shock waves by using quasi three-dimensional viscosity analyses. 3 refs., 20 figs.

5871 (ETDE/JP-mf–93753796, pp. 48-52) **Applications of gas turbine related numerical analyses and their problems.: Aerodynamic analysis of turbine cascade.** Tanaka, A. (Ishikawajima-Harima Heavy Industries, Co. Ltd., Tokyo (Japan)). Gas Turbine Society of Japan, Tokyo (Japan). 31 Mar 1992. 171p. (In Japanese). In *Problems on numerical analysis relating to gas turbines.: Basis and application examples.* Order Number DE93753796. Source: OSTI; NTIS (US Sales Only).

This paper describes numerical simulations for flows in compressors and rotating cascades in turbines. In an inter-blade blow simulation, conditions of the flows through each blade are calculated numerically to simulate them as a flow field equivalent to that in an experiment, and estimate whether the aerodynamic design performance requirement has been met. Experiments may limit measurements on flows in blades to a whole pressure at inlet and outlet of a cascade, temperatures, static pressures, and stator blade surface pressures, while simulations can estimate optional variables in optional cross sections. Simulations can also predict such elements in non-steady flows as shock wave faces with strong three-dimensionality, interference between shock waves and boundary layers, and diffusing afterwakes. Examples of applied simulations are described on two-dimensional inter-turbine blade flows, inter-blade flows in turbine cascades with strong three-dimensionality, and flows between a fan and a compressor cascade. A problem to be solved is to improve accuracies in quantitative estimation on vortices and afterwakes in three-dimensional compressive viscosity analyses, and cascade simulation techniques for back pressure gradients. 2 refs., 13 figs.

5872 (ETDE/JP-mf–93753796, pp. 53-56) **Applications of gas turbine related numerical analyses and their problems.: Numerical analysis of combustors.** Fuji, H. (Ishikawajima-Harima Heavy Industries, Co. Ltd., Tokyo (Japan)). Gas Turbine Society of Japan, Tokyo (Japan). 31 Mar 1992. 171p. (In Japanese). In *Problems on numerical analysis relating to gas turbines.: Basis and application examples.* Order Number DE93753796. Source: OSTI; NTIS (US Sales Only).

This paper describes numerical analysis of a gas turbine combustor. A damp diffuser is used to control flows so that air flow rate distribution in a combustor liner becomes insensitive to changes in velocity distribution at a combustor inlet to handle adequately the temperatures risen at the outlet. Particulate-in-flow micronizing injection valve and liner film cooling are also used to promote micronizing particulates in fuel and their mixing. Various analyses were carried out using a κ-ϵbinary equation for a turbulence model, an Arrhenius reactive velocity equation and a vortex collapse model for a chemical reaction model, and a particle source in cell (PSIC) model for droplets. The equations were given differentiation using a finite volumetric method, and the solution method used a semi-implicit method for pressure linked equation (SIMPLE). Rough identification of flow patterns and estimation on temperature distribution in the combustor liner were carried out satisfactorily in terms of qualification. However, improving quantitative accuracies in estimating pressure loss and temperature distribution requires accumulating verification data with high accuracy, not to speak of accuracies in models and analytical methods. 6 refs., 11 figs., 1 tab.

5873 (ETDE/JP-mf–93753796, pp. 57-62) **Applications of gas turbine related numerical analyses and their problems.: Aerodynamic analysis of compressor cascades.** Hashimoto, K. (Kawasaki Heavy Industries, Ltd., Tokyo (Japan)). Gas Turbine Society of Japan, Tokyo (Japan). 31 Mar 1992. 171p. (In Japanese). In *Problems on numerical analysis relating to gas turbines.: Basis and application examples.* Order Number DE93753796. Source: OSTI; NTIS (US Sales Only).

A verification was given on reliability in an analytic code when a computational fluid dynamics (CFD) is applied to aerodynamic designs of compressor cascades. Two-dimensional compressor cascade flow, three-dimensional cascade flow, and inter-impeller blade flow were analyzed. Levels of accuracy in computation using the current CFD technique are high quantitatively for two-dimensional cascades with low load, applicable satisfactorily for designs. However, cascades with high load make a sufficiently quantitative estimation difficult. This means that compressor cascades with large back pressure gradients tend to have boundary layers and separation regions grow, thus it is necessary to estimate the effct of separation and turbalence precisely in order to conduct a highly accurate analysis. It is especially important to develop a turbulence model applicable to separation flows. Sufficiently quantitative estimation on three-dimensional problems is still impossible. To use the CFD as a more practical design tool, increasing capacities and speeds of computers and reducing computation cost are also important. 13 figs., 2 tabs.

5874 (ETDE/JP-mf–93753796, pp. 63-70) **Examples of application of gas turbine related numerical analysis at the current stage and its problems.: Analysis of non-steady flow in turbine cascade.** Inoue, M. (Kyushu University, Fukuoka (Japan)); Furukawa, M. Gas Turbine Society of Japan, Tokyo (Japan). 31 Mar 1992. 171p. (In Japanese). In *Problems on numerical analysis relating to gas turbines.: Basis and application examples.* Order Number DE93753796. Source: OSTI; NTIS (US Sales Only).

This paper introduces an analysis of non-steady flow in turbine cascade from among gas turbine related numerical analyses. The paper also describes introduction of composite grids, development of a relaxation type negative TVD scheme, and its expansion to a non-steady scheme, as examples of their application related to developing schemes that can calculate compressive viscous flows around the cascade. The paper indicates particularly the following points: Composite grids are effective in suppressing reduction in computation accuracy due to the grid distortion; the relaxation type negative TVD scheme not applied with approximation factors has unconditional stability practically in an Eulerian analysis, and is capable of stable calculations even with a curan number of more than 10_5, or up to about 500 for Navier-Stokes analysis, serving usefully to structure schemes with high stability: and no correct solution may be obtained unless non-steady calculations are performed when grids with high spatial solution are used in analyzing cascade flows. 19 refs., 24 figs., 1 tab.

5875 (ETDE/JP-mf–93753796, pp. 71-81) **Examples of application of gas turbine related numerical analysis at the current stage and its problems.: Cascade numerical analysis and turbulence model.** Matsuo, Y. (National Aerospace Laboratory, Tokyo (Japan)). Gas Turbine Society of Japan, Tokyo (Japan). 31 Mar 1992. 171p. (In Japanese). In *Problems on numerical analysis relating to gas turbines.: Basis and application examples.* Order Number DE93753796. Source: OSTI; NTIS (US Sales Only).

This paper introduces a cascade numerical analysis and a turbulence model among gas turbine related numerical analyses. The paper first shows results of calculations on viscous flow analyses of two-dimensional single cascade using basic codes, and discusses problems as revealed by the calculations. Turbine cascade and compressor cascade are adopted as example of application. Although the examples of application are centered nearly on the design points, and the comparisons with experiments are greatly limited, they were sufficient to acquire characteristics of the codes. Application of the TVD scheme eliminated the need of adding

numerical viscosity positively as has been required in the conventional artificial viscosity scheme, and improved the calculation stability. As a result, improving the theoretical accuracy of solutions has become possible, and the spatial resolutions for impact waves and boundary layers were improved. However, from a viewpoint of improving the accuracy and the reliability, future works to be done would call for developing effective turbulence models and accumulating reliable experimental data. 16 refs., 8 figs., 2 tabs.

5876 (ETDE/JP-mf–93753796, pp. 82-92) **Examples of application of gas turbine related numerical analysis at the current stage and its problems.: Analysis of flows accompanying chemical reactions.** Wada, Y. (National Aerospace Laboratory, Tokyo (Japan)); Ishiguro, T. Gas Turbine Society of Japan, Tokyo (Japan). 31 Mar 1992. 171p. (In Japanese). In *Problems on numerical analysis relating to gas turbines.: Basis and application examples.* Order Number DE93753796. Source: OSTI; NTIS (US Sales Only).

This paper introduces an analysis of flows accompanying chemical reactions among gas turbine related numerical analyses. As seen from the position of numerically analyzing flows accompanying chemical reactions, jet engines and ram/scram jet engines are thought to have a number of common problems. Accordingly, the paper describes physical models for reactive flows and numerical analysis methods for these models from the above viewpoint. In numerical calculation methods, descriptions are given on expansion of Roe approximated Rieman solution, which is thought currently as one of the most outstanding schemes in terms of calculation efficiencies and resolutions, to non-equilibrium flows, and on time integration methods for reactive flows. In the calculation examples, problems in reactions induced by impact waves were solved, and a comparison was made among reaction models of Rogers, Orau and Westbrook. The paper then presents problems related to supersonic combustion in scram jet engines and a numerical simulation of a supersonic combustion experiment. 30 refs., 11 figs.

5877 (ETDE/JP-mf–93753796, pp. 93-99) **Examples of application of gas turbine related numerical analysis at the current stage and its problems.: Numerical analysis of blade tip clearance flow.** Watanabe, N. (Tokyo University of Agriculture and Technology, Tokyo (Japan)); Tamura, A. Gas Turbine Society of Japan, Tokyo (Japan). 31 Mar 1992. 171p. (In Japanese). In *Problems on numerical analysis relating to gas turbines.: Basis and application examples.* Order Number DE93753796. Source: OSTI; NTIS (US Sales Only).

This paper introduces a numerical analysis of blade tip clearance flow among gas turbine related numerical analyses. With an objective of elucidating characteristics of two-dimensional flow in a cascade caused from blade tip clearance, low subsonic flows passing through a static straight cascade were handled to establish an analytic method, and then calculations were proceeded to a high subsonic rotating fan and a transonic rotating turbine. Part of the results was compared with experimental values. Calculations intended to identify behaviors of blade tip leakage flows qualitatively have become possible to be performed on flows at levels in a cascade in the actual machine. The calculations enabled obtaining numerical data that can be used in various discussions to elucidate characteristics of complex three-dimensional flows including leakage flows and blade tip vortices caused from the blade tip clearance. On the other hand, studies to clarify experimentally complex three-dimensional flow fields in cascades have begun providing remarkably significant results supported by highly sophisticated measuring techniques. 7 refs., 19 figs.

5878 (ETDE/JP-mf–93753796, pp. 100-108) **Examples of application of gas turbine related numerical analysis at the current stage and its problems.: Analysis of heat transfer in gas turbine cooling blades.** Fukuyama, Y. (Toshiba Corp., Tokyo (Japan)); Kobayashi, T. Gas Turbine Society of Japan, Tokyo (Japan). 31 Mar 1992. 171p. (In Japanese). In *Problems on numerical analysis relating to gas turbines.: Basis and application examples.* Order Number DE93753796. Source: OSTI; NTIS (US Sales Only).

This paper introduces an analysis of heat transfer in gas turbine cooling blades among gas turbine related numerical analyses. Studies on analyzing heat transfer on blade outer surface have been performed centering on analyzing non-compressive two-dimensional turbulent boundary layers. What is discussed is not an issue of how to solve problems numerically, but what type of turbulence modelling should be used so that a heat transfer rate obtained as the result can explain experimental data and can be used as a predicting tool. This paper presents first examples of the conventional studies using different turbulence models in analyzing two-dimensional boundary layers, and then shows examples of analyses of heat transfer on blade surfaces. In comparing the experiments and the analyses on the distribution of blade outer face heat transfer rates, the L-S model has exhibited good analytic results. The problem enumerated first in analyzing the blade outer face heat transfer rates is that no analyses are possible in a sufficiently large scale. From an analytic cost and accuracy viewpoint, the analysis limit for the study purpose would be a three-dimensional Reynolds averaged NS equation plus a simple turbulence model. 39 refs., 8 figs., 5 tabs.

5879 (ETDE/JP-mf–93753796, pp. 109-116) **Examples of application of gas turbine related numerical analysis at the current stage and its problems.: Accuracy improvement in cascade flow analyzing methods.** Yamamoto, S. (Tohoku University, Sendai (Japan)); Daiguji, H. Gas Turbine Society of Japan, Tokyo (Japan). 31 Mar 1992. 171p. (In Japanese). In *Problems on numerical analysis relating to gas turbines.: Basis and application examples.* Order Number DE93753796. Source: OSTI; NTIS (US Sales Only).

This paper introduces improving the accuracy in cascade flow analyzing methods among gas turbine related numerical analyses. A high-resolution differential scheme was developed to analyze a non-steady flow passing through a transonic or supersonic cascade as a high-accuracy numerical analytic method. A high- resolution differential scheme indicates not only a differential scheme superior in capturing impact waves, but a differential scheme so devised that algorithms can function for impact wave capturing, turbulence calculation, and non-steady flow calculation. Cascade flows were calculated respectively on a transonic axial flow turbine, a transonic axial flow compressor, and a supersonic axial flow compressor, and compared with the experimental results. Subsequently, enumerated as problems in the CFD code were blade surface pressure distribution, equivalent Mach number distribution, outlet efflux angles, and total pressure loss, as well as from the points of calculation algorithms were the impact wave capturing algorithm, the non-steady flow calculation algorithm, and the turbulence calculation algorithm. 18 refs., 7 figs.

5880 (ETDE/JP-mf–93753796, pp. 117-135) **Examples of application of gas turbine related numerical analysis at the current stage and its problems.: Comparison and application of cascade aerodynamic analytic methods.** Shikano, Y. (Hitachi, Ltd., Tokyo (Japan)). Gas Turbine Society of Japan, Tokyo (Japan). 31 Mar 1992. 171p. (In Japanese). In *Problems on numerical analysis relating to gas turbines.: Basis and application examples.* Order Number DE93753796. Source: OSTI; NTIS (US Sales Only).

This paper introduces comparison and application of cascade aerodynamic analytic methods among gas turbine related numerical analyses. An explanation is given on methods to analyze numerical analysis programs using a three-dimensional inter-blade flow as an example. A quadratic equation turbulence model was introduced for the analytic methods to take the effect of turbulence into consideration. As calculation examples, results are shown on two-dimensional and three-dimensional steady flow analyses for turbine stages that can calculate ordinary inter-blade flows simultaneously with static and moving blades. Finally, examples of non-steady flow analysis are also presented. The inter-blade flow analysis is aimed chiefly at identifying fluid conditions in the inter-blade flows, and use the result thereof as a design tool to improve performances. The two-dimensional inter-blade flow analysis is an analytical program with its main purpose placed on improving the reliability, rather than improving fluid machine performance. The paper describes further problems in applying to designs the results of the inter-blade flow analysis dividing them into a numerical analysis method, a turbulence model, a calculation mesh, a computer, and a design system. 40 refs., 39 figs., 5 tabs.

5881 (ETDE/JP-mf–93753796, pp. 136-139) **Examples of application of gas turbine related numerical analysis at the current stage and its problems.: Aerodynamic analysis and experimental verification of turbine cascades.** Takagi, T. (Mitsui Engineering and Shipbuilding Co. Ltd., Tokyo (Japan)); Hashimoto, M. Gas Turbine Society of Japan, Tokyo (Japan). 31 Mar 1992. 171p. (In Japanese). In *Problems on numerical analysis relating to gas turbines.: Basis and application examples.* Order Number DE93753796. Source: OSTI; NTIS (US Sales Only).

This paper introduces aerodynamic analysis and experimental verification among gas turbine related numerical analyses. In basic design of a compressor and a turbine which are the major elements in a gas turbine, a basic stage design, rated point performance evaluation, and partially added performance evaluation are first performed. Then, detailed designs are carried out, including cascade design, stage design, and connecting path design, What is expected currently from the numerical analysis falls mainly under these detailed designs, and the analysis has begun being utilized together with stress analysis, vibration analysis, and heat transfer analysis. Accordingly, a transonic turbine was tested for its performance using a transonic turbine testing machine, and at the same time, pressure distributions on blade faces of static blades and on end wall faces of static blades were measured, The results were compared with solutions of axisymmetric three-dimensional Eulerian equations to discuss practicability of the fluid analytic method. Then, considerations were given on the current status and problems, and the future problems in applying the numerical analysis to designs. 3 refs., 10 figs.

5882 (ETDE/JP-mf–93753796, pp. 140-144) **Examples of application of gas turbine related numerical analysis at the current stage and its problems.: Aerodynamic design system for turbine cascades.** Aoki, S. (Mitsubishi Heavy Industries, Ltd., Tokyo (Japan)). Gas Turbine Society of Japan, Tokyo (Japan). 31 Mar 1992. 171p. (In Japanese). In *Problems on numerical analysis relating to gas turbines.: Basis and application examples.* Order Number DE93753796. Source: OSTI; NTIS (US Sales Only).

Designing an axial flow gas turbine uses the CFD codes. The CFD codes consist of quasi-three-dimensional and three-dimensional Eulerian codes and NS codes, both being used incorporated in the interactive design system, the TDSYS. This paper first presents examples of experimental verification in relation with the quasi-three-dimensional Eulerian codes. It then shows examples of verification with the three-dimensional Eulerian codes. The blade face Mach numbers for static blades both with low aspect ratio and high aspect ratio show a good agreement. Calculated flow rate turned out larger by about 2% than the measured flow rate. From these examples, the Eulerian codes may be said to have practically sufficient accuracy as far as turbine flows are concerned. The NS codes used currently use a turbulence model of Baldwin Lomax. The blade face Mach number distribution agreed with experimental values with a sufficient accuracy even with a presence of strong shock waves on the blade faces. Cascade passing flow rates agree well with experimental values. 4 refs., 9 figs.

5883 (ETDE/JP-mf–93753796, pp. 145-150) **Examples of application of gas turbine related numerical analysis at the current stage and its problems.: Aerodynamic analysis and experimental vertification of turbine cascades.** Nagayama, T. (Mitsubishi Heavy Industries, Ltd., Tokyo (Japan)). Gas Turbine Society of Japan, Tokyo (Japan). 31 Mar 1992. 171p. (In Japanese). In *Problems on numerical analysis relating to gas turbines.: Basis and application examples.* Order Number DE93753796. Source: OSTI; NTIS (US Sales Only).

Keeping the pace with wider use of super computers, Navier-Stokes calculations have become used routinely. This paper introduces a development of analytic codes for two-dimensional and three-dimensional viscous flows (Navier-Stokes calculation) and the verification results by comparing them with the experimental results using turbine cascades as the object. With typical turbine blade shapes as the object, calculation results were compared with experimental results to verify the two-dimensional codes. The experiment used an impact wind tunnel of air sucking type, and used a Mach-Zehnder interferometer to obtain isopycnic interference fringe photographs, while attaining cascade losses from a slip stream traversing experiment. This paper describes particularly flows accompanying break away flutter that can not be obtained from conventional non-viscosity analysis, and flows with shock waves and boundary layer interference. It further states a verification based on straight line cascades as well as a verification of a three-dimensional analysis on a single stage static turbine blades. The three-dimensional analysis calculates a huge physical amount, whereas an effective treatment and arrangement is an urgent requirement. 8 refs., 14 figs.

5884 (ETDE/JP-mf–93753796, pp. 151-155) **Problems in gas turbine related numerical analysis and peripheral techniques.: Problems in peripheral techniques.** Ishibashi, T. (Fujitsu Ltd., Tokyo (Japan)); Fukuda, M. Gas Turbine Society of Japan, Tokyo (Japan). 31 Mar 1992. 171p. (In Japanese). In *Problems on numerical analysis relating to gas turbines.: Basis and application examples.* Order Number DE93753796. Source: OSTI; NTIS (US Sales Only).

This paper introduces techniques peripheral to gas turbine related numerical analyses as to large-size computer hardwares, engineering work stations (EWS), software management, and image processing. First, with respect to large-size computers, it is predicted that the future mainstream would be a high-paralleled computer system to perform multiple processing by arranging a large number of currently available CPU, or calculations using a large number of inexpensive processors and main memories arranged in parallel, rather than pursuing ultra high-speed semiconductors. The EWSs have grown rapidly because of their compactness, low price, expanded softwares, and easy operation. Although EWSs have a number of advantages, they are not free of a few problems attributable to using them mainly for simulation calculations and available application softwares. The paper describes additionally general software problems, software management issues in CFD, peculiarities and problems in CFD image processing and the measures therefor. 6 figs., 2 tabs.

5885 (ETDE/JP-mf–93753796, pp. 156-166) **Problems in practical application of gas turbine related numerical analysis and its future outlook.: Problems and future outlook for practical application.** Tamura, A. (National Aerospace Laboratory, Tokyo (Japan)). Gas Turbine Society of Japan, Tokyo (Japan). 31 Mar 1992. 171p. (In Japanese). In *Problems on numerical analysis relating to gas turbines.: Basis and application examples.* Order Number DE93753796. Source: OSTI; NTIS (US Sales Only).

This paper introduces the problems in practical application of gas turbine related numerical analysis and its future outlook. First, a description is given on controlling equations and boundary conditions as the basic problem in the CFD technique, and on solutions to solve them discretely and numerically. The paper points out further the problems in verification through experiments and application. Studies in the world on numerical simulation techniques are not free from an impression of having reached a deadlock in qualitative aspects, and are trying to find their way out by looking for a direction of expanding the scope of application. Simultaneously with this temporary stagnation in qualitative transformation, the focus of interest is beginning to shift to the viewpoint of calling for practicability and reliability of the numerical simulation techniques. The direction expected in the new development of the CFD techniques would be the most basic solution algorithm for steady and non-steady Navier-Stokes equations, and original solution methods with higher accuracy stability and calculation efficiency and applicable to a wider range of Mach numbers regardless of whether they are compressive or non-compressive. 8 refs., 17 figs.

5886 (ETDE-mf–93744366, pp. 9-15) **Diesel exhaust particulates - formation and measurement.** Klingenberg, H. (Volkswagen AG, Wolfsburg (Germany)); Schuermann, D.; Lies, K.H. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Forschungszentrum Juelich GmbH (Germany). Projekttraeger Biologie, Energie, Oekologie; Bundesministerium fuer Forschung und Technologie, Bonn (Germany). 1992. 62p. (In German). In *Health effects of diesel exhaust gases. 5 years of research promotion.* Order Number DE93744366. Source: OSTI; NTIS (US Sales Only).

More recent theories about the combustion processes taking place under the engine hood are based on the assumption that

acetylene, being a readily reacting hydrogen compound, plays a key role in the formation of diesel exhaust particulate. The unification of several acetylene molecules to form large molecules showing ring structures leads to the development of different aromatic substances. These vary from two-ring structures like naphthalene and anthracene, which are the first compounds to be formed, to so-called polycyclic aromatic hydrocarbons that are characterised by multiple rings. If this unification of acetylene building blocks continues, the percentage shares of carbon are increased and those of hydrogen decreased, due to which fact graphite-like particles are gradually formed. This leads to the development of the more substantial 'primary particles' which, in turn, conglomerate and eventually form chains consisting of thousands of individual particles. For the characterisation and quantitative determination of those particles in exhaust gases, these must be filtered at a fixed temperature and air humidity. It was found that 71% of the filtrate were carbons or particulate and 24% organic compounds attached to the latter, while sulfate and metal oxides or other residues were detected in amounts of 3 and 2% of the total filtrate. (orig.).

5887 (NEI-NO–300) **The application of system identification techniques to performance monitoring of four stroke turbocharged diesel engines.** Molteberg, G.A. Trondheim Univ. (Norway). Norges Tekniske Hoegskole. Nov 1991. 187p. Order Number DE93752997. Source: OSTI; NTIS.

The thesis has two main objectives; firstly to mathematically model, simulate the performance and carry out a theoretical sensitivity analysis, and secondly to evaluate a new method for condition monitoring of four stroke turbocharged diesel engines based on system identification techniques and parameter estimation. Fault detection and diagnosis are illustrated by application of off-line parameter estimation techniques to a non-linear model of diesel engines. A recursive prediction error method was used to estimate parameters, corresponding to faults in a lumped parameter system. The results clearly indicate the feasibility of fault detection as well as diagnosis, that is, discrimination among faults occuring approximately at the same time. Among the objectives of early detection of malfunctions are the prevention of sudden failure of equipment, the improved planning of maintenance and performance. Measurements of dynamic cylinder pressures and mean values of compressor outlet temperature, air receiver pressure and temperature, exhaust receiver pressure and temperature, engine speed, turbine outlet temperature and turbocharger speed are used as input to the program. Bearing in mind the simple mathematical model of the diesel engine, the predicted variables show quite good agreement with measurements. A number of faults were investigated experimentally both individually and as multiple faults in order to test the method. Results showed that some of the parameters were more sensitive for detecting faults than the more traditionally used methods of trending measured variables. 111 refs., 59 figs., 36 tabs.

5888 (ORNL/M–2253) **Evaluation of Sialon internal combustion engine components and fabrication of several ceramic components for automotive applications.** McMurtry, C.H.; Ten Eyck, M.O. Oak Ridge National Lab., TN (United States). Oct 1992. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93003640. Source: OSTI; NTIS; GPO Dep.

Fabrication development work was carried out on a push-rod tip having a stepped OD design and a 90° shoulder in the transition area. Spray-dried Sialon premix was used in dry press tooling, and components were densified to about 98% of theoretical density using pressureless sintering conditions. Upon evaluation of the sintered components, it was found that afl components showed defects in the transition area. Modifications of the pressing parameters, incorporation of a 45° angle in the shoulder area, and the use of tailored premix did not lead to the fabrication of defect-free parts. From these observations, it was concluded that the original part design could not easily be adapted to high-volume ceramic manufacturing methods. Subsequently, a modification to the desip was implemented. An SiC material with improved toughness (Hexoloy SX) was used for fabricating several test components with a closely machined, straight OD design. Pressureless-sintered and post-hot isostatically pressed (HIPed) Hexoloy SX components were supplied to The American Ceramic Engine Company (ACE) for assembly and testing. Fuel pump push-rod assemblies with Hemoloy SX tips were prepared by ACE, but no testing has been carried out to date.

5889 (RFP–4667) **Reference handbook: Diesel engines and governors.** EG and G Rocky Flats, Inc., Golden, CO (United States). 18 Jan 1991. 31p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC34-90DP62349. Order Number DE93004210. Source: OSTI; NTIS; GPO Dep.

The purpose of this handbook is to provide Rocky Flats personnel with the information necessary to understand diesel engines and governors. Upon completion of this handbook you should be able to do the following tasks: Explain the two major differences between diesel and gasoline engines. Identify 12 major diesel engine components. Explain the function of pistons. Explain the functions of crankshafts and blowers. Define the following terms: Cylinder Block Crown End Skirt End Bosses Babbitt Compression Ignition Cycle Governor Speed Controller Fuel Injector. Describe how the crankshaft is related to the camshaft. Identify the purpose of a flywheel. Identify the four phases of the combustion cycle. Compare and contrast two-cycle and four-cycle engines. Explain the difference between a filter and a strainer. Scope: This handbook is designed for use by experienced Rocky Flats operators to reinforce and improve their current knowledge level, and by entry-level operators to ensure that they possess a minimum level of fundamental knowledge. Diesel Engines and Governors is applicable to many job classifications and can be used as a reference for classroom work or for self-study. Although this reference handbook is by no means all-encompassing, you will gain enough information about this subject area to assist you in contributing to the safe operation of Rocky Flats Plant.

5890 (VTT-JULK–761) **Exhaust emissions from diesel engines: Effects of starting and operating temperature and fuel.** Laurikko, J. (Technical Research Centre of Finland, Espoo (Finland). Lab. of Fuel and Process Technology). Technical Research Centre of Finland, Espoo (Finland). 1992. 51p. (In Finnish). Order Number DE93752852. Source: OSTI; NTIS.

The amount and composition of exhaust emissions from diesel engines at cold-start and before reaching the normal running temperature wet determined. Both direct injection and prechamber-type high-speed engines were studied. Experiments wet carried out in the temperature range of +20 - -30 deg C, applying bout constant and cyclic load during a half-an-hour test period. Emission test were also performed with the direct injection engine in accordance with the ECE R-49 regulation by keeping the engine at the running temperature and the ambient temperature lower than normally. All diesel fuels commercially available in Finland and one jet engine fuel suited also for diesel engines were used in the experiment. The measuring results indicated that the exhaust gas emissions from the direct injection engine change more than those from the precombustion chamber engine when the start-up and running temperatures decline. These differences may be due to differences in combustion chamber types. In the direct injection engine the emissions of carbon monoxide (CO) and unburnt hydrocarbons (HC) were increased by the decline in the start-up temperature, while the start-up temperature had only a minor effect on nitrogen oxide (NO_x) emissions. There were only insignificant differences between the tested fuel grades. The low ambient temperature also affected the emissions of the warmed-up engine. The CO and HC emissions increased, dependent on the fuel used, to 1.2–1.5-fold compared to those measured at a normal temperature, while the NO_x emissions remained practically unchanged. In the direct injection engine the formation of so-called white smoke was found to be intensive after the cold start-up.

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Refer also to citation(s) 7465

5891 (CONF-9209256–) **Electric and Hybrid Vehicle Technology: TOPTEC.** Society of Automotive Engineers, Inc., Warrendale, PA (United States). [1992]. 285p. Sponsored by

USDOE, Washington, DC (United States). DOE Contract FG02-92CH10504. From Electric & hybrid vehicle technology TOPTEC workshop; Dearborn, MI (United States); 14-15 Sep 1992. Order Number DE93002810. Source: OSTI; NTIS; INIS; GPO Dep.

Today, growing awareness of environmental and energy issues associated with the automobile has resulted in renewed interest in the electric vehicle. In recognition of this, the Society of Automotive Engineers has added a TOPTEC on electric vehicles to the series of technical symposia focused on key issues currently facing industry and government. This workshop on the Electric and Hybrid Vehicle provides an opportunity to learn about recent progress in these rapidly changing technologies. Research and development of both the vehicle and battery system has accelerated sharply and in fact, the improved technologies of the powertrain system make the performance of today's electric vehicle quite comparable to the equivalent gasoline vehicle, with the exception of driving range between "refueling" stops. Also, since there is no tailpipe emission, the electric vehicle meets the definition of "Zero Emission Vehicle: embodied in recent air quality regulations. The discussion forum will include a review of the advantages and limitations of electric vehicles, where the technologies are today and where they need to be in order to get to production level vehicles, and the service and maintenance requirements once they get to the road. There will be a major focus on the status of battery technologies, the various approaches to recharge of the battery systems and the activities currently underway for developing standards throughout the vehicle and infrastructure system. Intermingled in all of this technology discussion will be a view of the new relationships emerging between the auto industry, the utilities, and government. Since the electric vehicle and its support system will be the most radical change ever introduced into the private vehicle sector of the transportation system, success in the market requires an understanding of the role of all of the partners, as well as the new technologies involved.

5892 (NREL/TP–463-4952) **Environmental, health, and safety issues of sodium-sulfur batteries for electric and hybrid vehicles: Volume 4, In-vehicle safety.** Mark, J. National Renewable Energy Lab., Golden, CO (United States). Nov 1992. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE93000038. Source: OSTI; NTIS; GPO Dep.

This report is the last of four volumes that identify and assess the environmental, health, and safety issues that may affect the commercial-scale use of sodium-sulfur (Na/S) battery technology as the energy source in electric and hybrid vehicles. The reports are intended to help the Electric and Hybrid Propulsion Division of the Office of Transportation Technologies in the US Department of Energy (DOE/EHP) determine the direction of its research, development, and demonstration (RD&D) program for Na/S battery technology. The reports review the status of Na/S battery RD&D and identify potential hazards and risks that may require additional research or that may affect the design and use of Na/S batteries. This volume covers the in-vehicle safety issues of electric vehicles powered by Na/S batteries. The report is based on a review of the literature and on discussions with experts at DOE, national laboratories and agencies, and private industry. It has three major goals: (1) to identify the unique hazards associated with electric vehicle (EV) use; (2) to describe the existing standards, regulations, and guidelines that are or could be applicable to these hazards; and (3) to discuss the adequacy of the existing requirements in addressing the safety concerns of EVs.

5893 (TKK-S/SM–1989/21, pp. 27-34) **High-voltage inverter system for reduction of traction-transformer weight.** Oestlund, S. (The Royal Institute of Technology, Stockholm (Sweden). Dept. of Electrical Machines and Power Electronics). Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Electromechanics. 1989. (CONF-8901144–: Symposium on electrical power engineering at the Helsinki University of Technology, Espoo (Finland), 27 Jan 1989). In *Symposium on electrical power engineering.* 130p. Order Number DE93711132. Source: OSTI; NTIS.

In electric traction vehicles fed from a low frequency line voltage, typically 16 2/3, the main transformer adds considerably to weight and volume of the vehicle. By chopping the line voltage internally in the vehicle the transformer can be fed with a higher frequency, giving a smaller transformer with reduced weight and losses. A system with a naturally commutated high-voltage inverter has been studied. The investigation implies that at a frequency of 200 Hz it is possible to reduce the weight of the system by approximately 4 tonnes at a rated power of 5 MVA.

3304 Hybrid Systems

Refer also to citation(s) 5891, 5892, 7465

3305 Flywheel Propulsion

5894 (RISO-R–631) **Flywheel for vehicles 2.** Andersen, S.I.; Waagepetersen, G. Risoe National Lab., Roskilde (Denmark). Materials Dept. Jun 1992. 64p. (In Danish). Contract ENS-1243/90-0004. Order Number DE93752743. Source: OSTI; NTIS.

EFP-90.

A new type of flywheel for vehicles is developed from the wheel described in Risoe report M-2803. The storage of energy is further improved with 35% for same weight and volumen, and it is far better than existing flywheels for vehicles. The rim is made of fiber reinforced plastic coal-glas-PES. The main reason for the improvement is that the rim is connected to the expanded shaft by a cylinder made by reinforced plastic, which due to a special developed winding is very strong and without bending stresses or radial shear stresses at the connection to the shaft, which is made by a double overlap adhesion joint. Flywheels of this type can be made uniform from 3 kg to many tons. The wheel is universal applicable. (au) (13 ills.).

3307 Emission Control

5895 (ETDE-mf–93744366, pp. 53-56) **Ways to reduce the emission of diesel exhaust gases envisaged by the automotive industry.** Fortnagel, M. (Mercedes-Benz AG, Stuttgart (Germany)). GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Forschungszentrum Juelich GmbH (Germany). Projekttraeger Biologie, Energie, Oekologie; Bundesministerium fuer Forschung und Technologie, Bonn (Germany). 1992. 62p. (In German). In *Health effects of diesel exhaust gases. 5 years of research promotion.* Order Number DE93744366. Source: OSTI; NTIS (US Sales Only).

The considerable progress made in the reduction of diesel exhaust gas emissions from motorcars and utility vehicles has been the result of efforts made by the automotive industry over many years. These measures were not only restricted to those concerning the engine and the development of new engine technologies but also included strategies for the further treatment of the exhaust gases produced. The refinements to the engine are basically aimed at achieving an ideal mixture of air and fuel injected and, thus, an optimisation of the combustion process, which means that they are directly targeted at the injection system and firing chamber. New engine concepts for motorcars encompass innovations like electronic controlling systems for fuel injection, exhaust gas feedback or higher combustion through improved air supply, which is generally known as 'mild charging'. In the field of utility vehicles, an engine technology using exhaust gas turbo-charging and charge cooling appears to offer the most appropriate solution. This is a system, in which the air used in the combustion process is additionally cooled following compression. Further devices include automatic fuel consumption controllers like charge-limit stops, which restrict the volumes of fuel injected at any rotational speed to a permissible maximum, as well as ignition systems to improve cold start conditions. The measures for the further treatment of exhaust gases range from exhaust gas feedback and oxidation catalysers, which have already proven their value, to the development of particle filter systems that are still not quite satisfactory. (orig.).

5896 (KFK-PEF–80-Vol.2, pp. 757-769) **Separation of diesel soot particles with a combination of an agglomerator and a centrifugal separator.** Loeffler, F. (Inst. fuer Mechanische Verfahrenstechnik und Mechanik, Karlsruhe Univ. (T.H.) (Germany)); Wadenpohl, C. Kernforschungszentrum Karlsruhe GmbH

(Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265--: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7. status colloquium of the PEF project on March 5-7, 1991 at Karlsruhe Nuclear Research Center.* 458p. Order Number DE93744819. Source: OSTI; NTIS (US Sales Only).

This paper deals with the separation of soot particles from diesel engine exhaust fumes, using a two-stage separation system, which consists of an electrostatic agglomerator and a cyclone. The agglomerator is a unit which principally consists of an earthed tube with a specially shaped centrally mounted corona electrode, in a manner similar to a tubular electrode precipitator. The soot particles agglomerate under the influence of the high-tension supply, whereby the mechanism causing this, has not yet been fully clarified. As electromicroscopic images show, the maximum size of the agglomerates can reach more than 10 μm. Experiments with a light scattering size analyser showed, that the average size of the agglomerates increases with decreasing load of the diesel engine, which generates the soot particles. Further experiments are planned to investigate the influences of the cyclone geometry on disagglomeration effects, which have an unfavourable impact on the collection grade efficiency of the cyclone. The size distribution of the agglomerates together with the grade efficiency of the cyclone determines the total collection efficiency of the separation unit. Current experiments showed, that the total collection efficiency varies between 80% and 95%, depending on the operating conditions of the diesel engine. In addition to modifying the cyclone geometry, the most feasible method of improving the separation efficiency would be to create more compact agglomerates, possessing an adequate mechanical stability. This would reduce the danger of disagglomeration within the cyclone, hence also confining the negative effects on the total separation efficiency. Consequently, the agglomeration mechanism is to be investigated on a laboratory scale agglomerator for specific operational conditions. (orig./EF).

5897 (KFK-PEF-80-Vol.2, pp. 771-780) **Improvement of exhaust emissions of turbo-charged diesel engines in unsteady operation.** Hohenberg, G. (Fachgebiet Verbrennungskraftmaschinen, Technische Hochschule, Darmstadt (Germany)); Kuhnt, H.W. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265--: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7. status colloquium of the PEF project on March 5-7, 1991 at Karlsruhe Nuclear Research Center.* 458p. Order Number DE93744819. Source: OSTI; NTIS (US Sales Only).

The report consists of 3 main issues 1. reason for the higher soot emissions in the transient mode; 2. engine test in stationary and instationary mode; 3. concepts of solutions for lowering the transient emissions of particulate matter. The course of combustion is of significant importance to the formation of soot. Several parameters, such as the maximum heat release, position of main combustion as regards TDC etc., may be used to describe the combustion process. Because the course of combustion in the Diesel engine is influenced by the process of mixture formation, a calculation model for the trajectory and vaporization has been developed. On the basis of test and calculation results a formula was developed, which describes the most important influences such as supplied air, course of pressure and temperature, engine speed and course of vaporization on the emitted mass of soot. (orig.).

3308 Alternative Fuels

Refer also to citation(s) 4971

5898 (DOE/CE/27504-2) **Technical comparison between Hythane, GNG and gasoline fueled vehicles.** Urban Consortium for Technology Initiatives (United States). Energy Task Force; Public Technology, Inc., Washington, DC (United States); Denver Alternative Fuels Unit, CO (United States). May 1992. 78p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90CE27504. Order Number DE93005608. Source: OSTI; NTIS; INIS; GPO Dep.

This interim report documents progress on this 2-year Alternative Fuel project, scheduled to end early 1993. Hythane is 85 vol% compressed natural gas (CNG) and 15 vol% hydrogen; it has the potential to meet or exceed the California Ultra-Low Emission Vehicle (ULEV) standard. Three USA trucks (3/4 ton pickup) were operated on single fuel (unleaded gasoline, CNG, Hythane) in Denver. The report includes emission testing, fueling facility, hazard and operability study, and a framework for a national hythane strategy.

5899 (DOE/CE/27504-5) **Analysis of operational, institutional and international limitations for alternative fuel vehicles and technologies: Means/methods for implementing changes.** Urban Consortium for Technology Initiatives (United States). Energy Task Force; Public Technology, Inc., Washington, DC (United States); Detroit Buildings and Safety Engineering Dept., MI (United States). Jul 1992. 89p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90CE27504. Order Number DE93005611. Source: OSTI; NTIS; INIS; GPO Dep.

This project focused upon the development of an approach to assist public fleet managers in evaluating the characteristics and availability of alternative fuels (AF's) and alternative fuel vehicles (AFV's) that will serve as possible replacements for vehicles currently serving the needs of various public entities. Also of concern were the institutional/international limitations for alternative fuels and alternative fuel vehicles. The City of Detroit and other public agencies in the Detroit area were the particular focus for the activities. As the development and initial stages of use of alternative fuels and alternative fuel vehicles proceeds, there will be an increasing need to provide information and guidance to decision-makers regarding differences in requirements and features of these fuels and vehicles. There wig be true differences in requirements for servicing, managing, and regulating. There will also be misunderstanding and misperception. There have been volumes of data collected on AFV'S, and as technology is improved, new data is constantly added. There are not, however, condensed and effective sources of information for public vehicle fleet managers on vehicle and equipment sources, characteristics, performance, costs, and environmental benefits. While theoretical modeling of public fleet requirements has been done, there do not seem to be readily available "practical". There is a need to provide the best possible information and means to minimize the problems for introducing the effective use of alternative fuels and alternative fuel vehicles.

5900 (DOE/CE/27504-12) **Alternative transportation fuels: Financing issues: Options for financing alternative fuel vehicles fleets and infrastructure.** Squadron, W.F.; Ward, C.O.; Brown, M.H. Urban Consortium for Technology Initiatives (United States). Energy Task Force; Public Technology, Inc., Washington, DC (United States); New York City Dept. of Telecommunications and Energy, NY (United States). Jun 1992. 71p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90CE27504. Order Number DE93005620. Source: OSTI; NTIS; INIS; GPO Dep.

A multitude of alternative fuels could reduce air pollution and the impact of oil price shocks. Only a few of these fuels are readily available and inexpensive enough to merit serious consideration over the coming five years. In New York City, safety regulations narrow the field still further by eliminating propane. As a result, this study focuses on the three alternative fuels readily available in New York City: compressed natural gas, methanol, and electricity. Each has significant environmental benefits and each has different cost characteristics. With the Clean Air Act and the National Energy Strategy highlighting the country's need to improve urban air quality and move away from dependence on imported fuels, fleets may soon have little choice but to convert to alternative fuels. Given the potential for large infrastructure and vehicle costs, these fleets may have difficulty finding the capital to make that conversion. Ultimately, then, it will be the involvement of the private sector that will determine the success of alternative fuels. Whether it be utilities, fuel distributors or suppliers, private financing partners or others, it is critical that alternative fuels programs be structured and planned to attract their involvement. This report examines financing methods that do not involve government subsidies. It also explores

financing methods that are specific to alternative fuels. Bond issues and other mechanisms that are used for conventional vehicles are not touched upon in this report. This report explores ways to spread the high cost of alternative fuels among a number of parties within the private sector. The emphasis is on structuring partnerships that suit methanol, electric, or natural gas vehicle fleets. Through these partnerships, alternative fuels may ultimately compete effectively against conventional vehicle fuels.

5901 (DOE/CE/50280–T1) **Alcohol Transportation Fuels Demonstration Program: Phase 1.** Kinoshita, C.M. (ed.). Hawaii Natural Energy Inst., Honolulu, HI (United States). [1990]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG01-88CE50280. Order Number DE93006099. Source: OSTI; NTIS; GPO Dep.

Hawaii has abundant natural energy resources, especially biomass, that could be used to produce alternative fuels for ground transportation and electricity. This report summarizes activities performed during 1988 to June 1991 in the first phase of the Alcohol Transportation Fuels Demonstration Program. The Alcohol Transportation Fuels Demonstration Program was funded initially by the Energy Division of the State of Hawaii's Department of Business, Economic Development and Tourism, and then by the US Department of Energy. This program was intended to support the transition to an alternative transportation fuel, methanol, by demonstrating the use of methanol fuel and methanol-fueled vehicles, and solving the problems associated with that fuel. Specific objectives include surveying renewable energy resources and ground transportation in Hawaii; installing a model methanol fueling station; demonstrating a methanol-fueled fleet of (spark-ignition engine) vehicles; evaluating modification strategies for methanol-fueled diesel engines and fuel additives; and investigating the transition to methanol fueling. All major objectives of Phase I were met (survey of local renewable resources and ground transportation, installation of methanol refueling station, fleet demonstration, diesel engine modification and additive evaluation, and dissemination of information on alternative fueling), and some specific problems (e.g., relating to methanol fuel contamination during handling and refueling) were identified and solved. Several key issues emerging from Phase I (e.g., methanol corrosion, flame luminosity, and methanol-transition technoeconomics) were recommended as topics for follow-on research in subsequent phases of this program.

5902 (DOE/IR/05106–T160) **Economic Evaluation Guide for alternative transportation fuels.** de Percin, D.; Werner, J.F. Jr. Urban Consortium for Technology Initiatives (United States). Energy Task Force; Public Technology, Inc., Washington, DC (United States). [1992]. 108p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-78IR05106. Order Number DE93005623. Source: OSTI; NTIS; GPO Dep.

The production of this Economic Evaluation Guide is one activity of AVFCAP. The guide is intended for use by project managers and fleet operators in the public sector. Public fleets have been identified as one of the most likely areas where ATFs will first gain widespread use, because of existing and impending state and federal legislative mandates, as well as for practical reasons such as centralized servicing and refueling. The purpose of this guide is to provide balanced decision-support information to project managers who are considering conducting, or currently managing, ATF demonstration programs. Information for this guide was gathered as part of a related AVFCAP activity, the development of an Information Resource Database. Economic issues related to the development and implementation of ATF programs at the local government level are extremely complex, and require an analysis of federal policies and national and international economics that is generally beyond the scope of local government project managers. The intent of this guide is to examine the information available on the economic evaluation of ATFs, and identify key elements that will help local governments realistically assess the potential costs and savings of an ATF program. The guide also discusses how these various economic factors are related, and how local government priorities affect how different factors are weighed.

35 ARMS CONTROL

5903 (CONF-9208174–Vol.1) **Program on stability and the offense/defense relationship conference final report: Volume 1.** Marshall, T.J.; Gill, J.M. Science Applications International Corp., McLean, VA (United States). 16 Oct 1992. 32p. Sponsored by Department of Defense, Washington, DC (United States); USDOE, Washington, DC (United States). Contract AC92SC1003. From 7. conference on stability and the offense/defense relationship; Monterey, CA (United States); 26-27 Aug 1992. Order Number DE93002033. Source: OSTI; NTIS; GPO Dep.

This document is the final report for the August 26–27, 1992 Conference on Stability and the Offense/Defense Relationship held in Monterey, California. This final report is in two volumes. This document, volume one, reports the conference's findings, and volume two contains speakers' presentations.

5904 (CONF-9208174–Vol.2) **Program on stability and the offense/defense relationship conference final report: Volume 2.** Marshall, T.J.; Gill, J.M. Science Applications International Corp., McLean, VA (United States). 16 Oct 1992. 157p. Sponsored by Department of Defense, Washington, DC (United States); USDOE, Washington, DC (United States). Contract AC92SC1003. From 7. conference on stability and the offense/defense relationship; Monterey, CA (United States); 26-27 Aug 1992. Order Number DE93002034. Source: OSTI; NTIS; GPO Dep.

This document presents Volume two of the Final Report for the August 26–27, 1992 Conference on Stability and the Offense/Defense Relationship held in Monterey, California. The final report is in two volumes. Volume one reports the conference's findings, and volume two contains the speakers' presentations. Individual presentations in this document, volume two, are cataloged separately.

3502 Proliferation

Refer also to citation(s) 5066

5905 (LA–12430-MS) **Nuclear weapon proliferation indicators and observables.** Paternoster, R.R. Los Alamos National Lab., NM (United States). Dec 1992. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93002659. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report discusses indicators and observables that might be present from various phases of a nuclear weapon development effort. The indicators themselves are accompanied by some general discussions of what is likely to be observable by inspection or sampling techniques. The areas discussed include nuclear materials production, materials fabrication, related technology development, testing, and scientific personnel. Brief discussions of on-site inspections, sampling techniques, and evasion of safeguards are also included.

3503 Verification

Refer also to citation(s) 6379

5906 (DOE/DP/OAC/VT–92A) **Verification Technologies, first/second quarters 1992.** Staehle, G. (Lawrence Livermore National Lab., CA (United States)); Talaber, C.; Stull, S. (eds.). Lawrence Livermore National Lab., CA (United States); USDOE Office of Arms Control and Nonproliferation, Washington, DC (United States). [1992]. 64p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93001562. Source: OSTI; NTIS; GPO Dep.

The purpose of this document is to enhance communication between the technologists who study the means to verify compliance with the policy makers who negotiate treaties. Topics discussed include: microwave dielectrometer for chemical weapon (cw) verification; fourier-transform ultrasonic interrogation of sealed chemical and conventional munitions; low-power portable x-ray system for chemical treaty verification; portable isotopic neutron spectroscopy for nondestructive evaluation of cw; laser acoustic spectroscopy for cw verification; ion-tube neutron spectroscopy; frequency response method; acoustic resonance spectroscopy; ultrasonic pulse-echo

measurements for cw verification; and investigating fluid-filled munitions with inertial damping.

36 MATERIALS

Refer also to citation(s) 5734, 6829, 7138, 7139

5907 (ANL/CP–72336) **Nanostructured materials.** Siegel, R.W. Argonne National Lab., IL (United States). Sep 1992. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9109446–1: 1. Mexico-USA symposium on the frontiers in materials science, Ixtapa (Mexico), 24-27 Sep 1991). Order Number DE93002990. Source: OSTI; NTIS; GPO Dep.

The recently developed ability to synthesize materials from atomic precursors under controlled conditions on a nanometer size scale (below 100 nm) has the potential for revolutionizing materials science and engineering. Such nanostructured materials can now be synthesized with modulation dimensionalities form zero (clusters) to three (nanophase materials), each with their own particular advantages. These advantages stem from such diverse effects as for example quantum confinement elastic strain accommodation, and grain size limitations. The general principles of nanostructured materials are considered and the particular opportunities for producing bulk nanophase materials with engineered properties, via the synthesis of metal and ceramic atom clusters followed by their in-situ assembly under controlled conditions, are presented as an example.

5908 (ANL/MCT/RP–77582) **Materials and Components Technology Division research summary, 1992.** Argonne National Lab., IL (United States). Materials and Components Technology Div. Nov 1992. 158p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93004228. Source: OSTI; NTIS; INIS; GPO Dep.

The Materials and Components Technology Division (MCT) provides a research and development capability for the design, fabrication, and testing of high-reliability materials, components, and instrumentation. Current divisional programs related to nuclear energy support the development of the Integral Fast Reactor (IFR): life extension and accident analyses for light water reactors (LWRs); fuels development for research and test reactors; fusion reactor first-wall and blanket technology; and safe shipment of hazardous materials. MCT Conservation and Renewables programs include major efforts in high-temperature superconductivity, tribology, nondestructive evaluation (NDE), and thermal sciences. Fossil Energy Programs in MCT include materials development, NDE technology, and Instrumentation design. The division also has a complementary instrumentation effort in support of Arms Control Technology. Individual abstracts have been prepared for the database.

5909 (LA-UR–92-3783) **Data-parallel Langevin dynamics simulations.** Lomdahl, P.S. Los Alamos National Lab., NM (United States). 9 Nov 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9205229–2: Center for Nonlinear Studies (CNLS) conference: nonlinearity in materials science, Los Alamos, NM (United States), May 1992). Order Number DE93003836. Source: OSTI; NTIS; GPO Dep.

The basic principles of data-parallel programming on massively parallel computers is outlined and illustrated with examples from Langevin dynamics simulations of surface growth in the presence of dislocation defects.

5910 (NREL/CP–412-5007) **Current status, research needs, and opportunities in applications of surface processing to transportation and utilities technologies: Proceedings of a December 1991 workshop.** Czanderna, A.W.; Landgrebe, A.R. (eds.). National Renewable Energy Lab., Golden, CO (United States). Sep 1992. 426p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. (CONF-9112112–: Current status, research needs, and opportunities in applications of surface processing applications to transportation and utilities technologies, Washington, DC (United States), 10-12 Dec 1991). Order Number DE92016446. Source: OSTI; NTIS; GPO Dep.

Goal of surface processing is to develop innovative methods of surface modification and characterization for optimum performance and environmental protection for cost-effective operational lifetimes of systems, materials, and components used in transportation and utilities. These proceedings document the principal discussions and conclusions reached at the workshop; they document chapters about the current status of surface characterization with focus on composition, structure, bonding, and atomic-scale topography of surfaces. Also documented are chapters on the current status of surface modification techniques: electrochemical, plasma-aided, reactive and nonreactive physical vapor deposition, sol-gel coatings, high-energy ion implantation, ion-assisted deposition, organized molecular assemblies, solar energy. Brief chapters in the appendices document basic research in surface science by NSF, Air Force, and DOE. Participants at the workshop were invited to serve on 10 working groups. Separate abstracts were prepared for the data base where appropriate.

5911 (ORNL/FMP–92/2) **Fossil Energy Advanced Research and Technology Development Materials Program: Semiannual progress report for the period ending September 30, 1992.** Cole, N.C.; Judkins, R.R. (comps.). Oak Ridge National Lab., TN (United States). Dec 1992. 337p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93004433. Source: OSTI; NTIS; GPO Dep.

Objective of this materials program is to conduct R and D on materials for fossil energy applications with focus on longer-term and generic needs of the various fossil fuel technologies. The projects are organized according to materials research areas: (1) ceramics, (2) new alloys: iron aluminides, advanced austenitics and chromium niobium alloys, and (3) technology development and transfer. Separate abstracts have been prepared.

3601 Metals and Alloys

Refer also to citation(s) 4843, 4932, 5021, 5059, 5071, 5076, 5172, 5177, 5220, 5382, 5383, 5384, 5385, 5390, 5392, 5393, 5394, 5395, 5396, 5397, 5398, 5399, 5400, 5420, 5457, 5458, 5459, 5460, 5461, 5462, 5489, 5509, 5597, 5603, 5619, 5824, 5861, 6008, 6023, 6075, 6133, 6134, 6144, 6156, 6157, 6159, 6185, 6250, 6265, 6268, 6321, 7082, 7085, 7123, 7251, 7252, 7253, 7255, 7256, 7258, 7259, 7260, 7261, 7262, 7263, 7264, 7265, 7266, 7267, 7268, 7269, 7270, 7271, 7272, 7273, 7274, 7275, 7276, 7277, 7278, 7279, 7280, 7281, 7282, 7286, 7288, 7289, 7291, 7295, 7299, 7301, 7302, 7303, 7304, 7305, 7307, 7308, 7309, 7310, 7311, 7312, 7313, 7314, 7315, 7316, 7317, 7318, 7319, 7320, 7323, 7340, 7341, 7342, 7343, 7344, 7345, 7346, 7347, 7348, 7349, 7350, 7351, 7352, 7353, 7355, 7356, 7357, 7358, 7359, 7360, 7361, 7362

5912 (AEA-RS–5164) **The interaction of caesium hydroxide vapour with 304 stainless steel and Inconel-600.** Sabathier, F. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France)). AEA Reactor Services, Winfrith (United Kingdom). Dec 1991. [29] Order Number DE93608969. Source: OSTI; NTIS (US Sales Only); INIS.

Experiments have been conducted to characterise the oxidation of 304 stainless steel and Inconel-600 and their interaction with caesium hydroxide vapour under the conditions expected to occur in the primary circuit region of the Phebus-FP experiments. Oxide deposits formed on 304stainless steel at 700°C in a steam atmosphere were shown to be adherent, with no evidence of spallation. The reaction of caesium hydroxide vapour with Inconel-600 in steam at 700°C was a factor of two to three less than the equivalent reaction with stainless steel. The degree of reaction appears to be related to the extent of oxide formation, with a thinner, more compact, surface oxide formed on Inconel-600 than 304 stainless steel. These results indicate that retention in Inconel pipework in Phebus-FP would be less than with an equivalent stainless steel system, thus ensuring more neutral conditions and greater transport of material to the containment vessel. (author).

5913 (ANL/CHM/CP–77746) **Surface melting in Ni_{55}.** Guevenc, Z.B.; Jellinek, J. Argonne National Lab., IL (United States). 16 Sep 1992. 4p. Sponsored by USDOE, Washington, DC

(United States). DOE Contract W-31109-ENG-38. (CONF-920921–5: 6. international symposium on small particles and inorganic clusters, Chicago, IL (United States), 16-22 Sep 1992). Order Number DE93003008. Source: OSTI; NTIS; GPO Dep.

The phenomenon of surface melting in a Ni_{55} cluster is predicted from results of molecular dynamics simulations.

5914 (ANL/CP–76457) **Magnetic decoupling in sputtered Fe/Si superlattices and multilayers.** Fullerton, E.E. (Argonne National Lab., IL (United States)); Mattson, J.E.; Lee, S.R.; Sowers, C.H.; Huang, Y.Y.; Felcher, G.; Bader, S.D.; Parker, F.T. Argonne National Lab., IL (United States). Sep 1992. 14p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States); Government of the Republic of Korea, Seoul (Korea, Republic of). DOE Contract W-31109-ENG-38. DMR86-03304;DMR90-10908. (CONF-921201–10: Conference on magnetism and magnetic materials, Houston, TX (United States), 1-4 Dec 1992). Order Number DE93004204. Source: OSTI; NTIS; GPO Dep.

A series of sputtered Fe/Si superlattices was grown to study the magnetic coupling between ferromagnetic Fe layers (30Å thick) for Si spacer-layer thicknesses (t_{Si}) between 10 and 40Å. The material is ferromagnetically coupled for $t_{Si}<13$Å and antiferromagneticly coupled for $13Å<t_{Si}<17Å$. For $t_{Si}>17$Å the magnetic Fe layers are uncoupled. X-ray analysis indicates that the system is well layered, but that the crystal structure remains coherent only for $t_{Si}<17$Å. These results, along with our Moessbauer investigation, strongly suggest that the Si layer is crystalline for $t_{Si}<17$Å, and is iron silicide in nature. For thicker spacers, Si becomes amorphous. We propose a model of the layering that is consistent with the known properties of Fe-silicide.

5915 (ANL/CP–76458) **Oscillatory interlayer magnetic coupling of sputtered Fe/Nb superlattices.** Mattson, J.E.; Fullerton, E.E.; Sowers, C.H.; Huang, Y.Y.; Felcher, G.P.; Bader, S.D. Argonne National Lab., IL (United States). Sep 1992. 13p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract W-31109-ENG-38. DMR-86-03304. (CONF-921201–11: Conference on magnetism and magnetic materials, Houston, TX (United States), 1-4 Dec 1992). Order Number DE93004191. Source: OSTI; NTIS; GPO Dep.

The saturation field of sputtered Fe/Nb superlattices oscillates as a function of the Nb thickness with a periodicity of ~9 Å. In contrast to the case of Fe/Cr superlattices, the concurrent magnetoresistance oscillations were found to be very weak. Yet polarized neutron reflection measurements confirm that the Fe/Nb superlattices with high saturation field possess a magnetic ground state of the ±± type. Neutron and x-ray measurements indicate that, while the crystalline and antiferromagnetic order is well developed along the thickness of the film, the average lateral size of the crystallites (as well as of the magnetic domains) is quite small. This effect (thought to be related to the gross mismatch of the iron and the niobium crystal lattices) may be the cause of the high overall resistance of the material, and its weak dependence on the magnetization.

5916 (ANL/FE/CP–75641) **Reusable molds for casting U-Zr alloys.** Chen, P.S. (Advanced Technology Materials, Inc., Danbury, CT (United States)); Stevens, W.C.; Trybus, C.L. Argonne National Lab., Idaho Falls, ID (United States). Sep 1992. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38 ;FG01-90ER81079. (CONF-921109–4: Fall meeting of the Metallurgical Society and American Institute of Metallurgical and Petroleum Engineers, Chicago, IL (United States), 1-5 Nov 1992). Order Number DE93004241. Source: OSTI; NTIS; INIS; GPO Dep.

Refractory oxides, carbides, nitrides and sulfides were examined as mold coating materials for use in casting nuclear fuel. The molds require excellent high temperature chemical and mechanical stability combined with reasonable room temperature ductility to allow for fuel removal. Coatings were applied onto quartz and refractory metal coupons using various techniques. Sessile drop tests employing molten U-10%Zr (by weight) at 1550°C were used to characterize coating performance. Results indicate that NbC, TiN, and Y_2O_3 were non-wetting with U-10%Zr. However, only the Y_2O_3 coating completely prevented adhesion of the fuel. The paper describes coating methods and details of the sessile drop experiments.

5917 (ANL/MCT/CP–74743) **Stress corrosion cracking susceptibility of irradiated Type 304 stainless steels.** Chung, H.M.; Ruther, W.E.; Sanecki, J.E.; Kassner, T.F. Argonne National Lab., IL (United States). Materials and Components Technology Div. Aug 1992. 19p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9206282–2: 16. ASTM international symposium on the effects of radiation on materials(ISERM), Aurora, CO (United States), 23-25 Jun 1992). Order Number DE93003005. Source: OSTI; NTIS; INIS; GPO Dep.

Slow-strain-rate tensile tests and microstructural analysis by Auger electron spectroscopy were conducted on specimens of high- and commercial-purity (HP and CP) heats of Type 304 stainless steel obtained from neutron absorber tubes and a control blade sheath after irradiation up to 2.5×10^{21} n-cm^{-2} (E > I MeV) in boiling water reactors (BWRs). The susceptibility of the HP absorber tubes to intergranular stress corrosion cracking (IGSCC) was higher than that of the CP absorber tubes or the CP control blade sheath. IGSCC susceptibilities of the BWR components could not be correlated to segregation impurities on grain boundaries. However for comparable fluence levels, Cr on grain-boundaries.

5918 (ANL/MSD/CP–77539) **Diffraction studies of the thermal properties of nanocrystalline Pd and Cr.** Eastman, J.A. (Argonne National Lab., IL (United States)); Thompson, L.J.; Fitzsimmons, M.R.; Lawson, A.C.; Robinson, R.A. Argonne National Lab., IL (United States). Sep 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38 ;W-7405-ENG-36. (CONF-920947–2: Conference on nanostructured materials, Cancun (Mexico), 21-25 Sep 1992). Order Number DE93002911. Source: OSTI; NTIS; GPO Dep.

Quantitative X-ray and neutron diffraction measurements were made on nanocrystalline and coarse-grained samples of Pd and Cr. For both materials, Debye-Waller parameter comparisons over a temperature range of approximately 20-300 K indicate that the nanocrystalline materials have increased static displacements of atoms from their equilibrium sites compared to coarse-grained material. No grain-size-correlated differences in thermal vibrational amplitude, lattice parameter, or thermal expansion coefficients were observed in either material. In contrast to earlier results on nanocrystalline Pd, significantly more non-peak intensity is observed from a nanocrystalline Cr sample than from a coarse-grained Cr sample. Impurities may account for the increased background intensity from nanocrystalline Cr. These results indicate that there is no significant grain boundary excess volume in nanocrystalline Pd, and therefore the reduced density typically observed in nanocrystalline Pd samples must be due to porosity.

5919 (ANL/MSD/CP–77654) **Magnetic structures of nanometer scale Dy, Cr and Ni.** Fitzsimmons, M.R. (Los Alamos National Lab., NM (United States)); Robinson, R.A.; Lawson, A.C.; Kwei, G.H.; Sickafus, K.E.; Eastman, J.A.; Burkel, E. Argonne National Lab., IL (United States). Oct 1992. 7p. Sponsored by USDOE, Washington, DC (United States); Bundesministerium fuer Forschung und Technologie, Bonn (Germany). DOE Contract W-31109-ENG-38 ;W-7405-ENG-36. Contract 03PE1LMU/2. (LA-UR–92-3385;CONF-920947–4: Conference on nanostructured materials, Cancun (Mexico), 21-25 Sep 1992). Order Number DE93002984. Source: OSTI; NTIS; GPO Dep.

Materials composed of nanometer-sized structures are becoming technologically relevant as the sizes of electronic devices approach the nanometer scale. Questions as to the performance and durability of these devices can be partially addressed through the characterization and understanding of the magnetic structures and properties of nanometer-sized materials. The purpose of the present work is to understand the relationship between the microstructure of nanocrystalline materials and their magnetic structures and properties. This paper summarizes three separate experiments: (1) an X-ray diffraction and anomalous absorption (XANES) study of nanocrystalline Dy, (2) neutron diffraction measurements of the magnetic structure of nanocrystalline Cr, and (3)

the measurement of the magnetization density of a single twist grain boundary in Ni.

5920 (ANL/MSD/CP–78010) **Non-equilibrium structures induced by ion irradiation in Ni_4Mo.** Bellon, P. (CEREM/SRMP, CE Saclay, Gif-sur-Yvette (France)); Okamoto, P.R.; Schumacher, G. Argonne National Lab., IL (United States). Nov 1992. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-920970–5: 3. conference on evolution of microstructure in metals during irradiation, Minett (Canada), 29 Sep - 2 oct 1992). Order Number DE93004193. Source: OSTI; NTIS; INIS; GPO Dep.

We have studied the stability of equilibrium and metastable ordered phases (called LRO and SRO respectively) in Ni_4Mo during 500-keV Ne or 250-keV He irradiations. Some irradiations were performed in situ, allowing thus to follow the evolution of the samples, which were characterized by Transmission Electron Microscopy. Dynamical equilibrium phase diagrams are built, by varying the irradiation flux, temperature and dose. At a fixed ion flux, there exists a temperature range were a "mixed" ordered state is stabilized, and remains stable up to the maximum doses reached (1.7 dpa). This state, which cannot be obtained by electron irradiation, consists in the coexistence of the two ordered phases at a very fine scale ($\leq$ 2nm). Comparison with results already reported after electron irradiation is made, stressing the role played by displacement cascades in our results. Furthermore we observed alignment of dislocation loops along, the [001] c-axis of the quadratic LRO phase.

5921 (ANL/MSD/CP–78164) **Reconstruction of twist grain boundaries in gold.** Phillpot, S.R. Argonne National Lab., IL (United States). Nov 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-921101–21: 16. Material Research Society international symposium on the scientific basis for nuclear waste management fall meeting, Boston, MA (United States), 30 Nov - 5 dec 1992). Order Number DE93004861. Source: OSTI; NTIS; GPO Dep.

The reconstruction of high-angle twist grain boundaries on the four densest atomic planes in gold are investigated using the recently developed method of grand-canonical simulated quenching. It is found that the grain boundaries on the two densest planes, (111) and (100), do not reconstruct, while those on the (110) and (113) planes do.

5922 (ANL/RE/CP–75828) **Strength and rupture-life transitions caused by secondary carbide precipitation in HT-9 during high-temperature low-rate mechanical testing.** DiMelfi, R.J.; Gruber, E.E.; Kramer, J.M.; Hughes, T.H. Argonne National Lab., IL (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-921109–3: Fall meeting of the Metallurgical Society and American Institute of Metallurgical and Petroleum Engineers, Chicago, IL (United States), 1-5 Nov 1992). Order Number DE93002917. Source: OSTI; NTIS; INIS; GPO Dep.

The martensitic-ferritic alloy HT-9 is slated for long-term use as a fuel-cladding material in the Integral Fast Reactor. Analysis of published high-temperature mechanical property data suggests that secondary carbide precipitation would occur during service life causing substantial strengthening of the as-heat-treated material. Aspects of the kinetics of this precipitation process are extracted from calculations of the back stress necessary to produce the observed strengthening effect under various creep loading conditions. The resulting Arrhenius factor is shown to agree quantitatively with shifts to higher strength of crept material in reference to the intrinsic strength of HT-9. The results of very low constant strain-rate high-temperature tensile tests on as-heat-treated HT-9 that focus on the transition in strength with precipitation will be presented and related to rupture-life.

5923 (BNL–48026) **High-energy spin-density-wave correlated fluctuations in paramagnetic Cr + 5 at. % V.** Werner, S.A. (Missouri Univ., Columbia, MO (United States). Dept. of Physics); Fawcett, E.; Elmiger, M.W.; Shirane, G. Brookhaven National Lab., Upton, NY (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States); Natural Sciences and Engineering Research Council of Canada, Ottawa, ON (Canada). DOE Contract AC02-76CH00016. Grant PHY-9024608. (CONF-921201–7: Conference on magnetism and magnetic materials, Houston, TX (United States), 1-4 Dec 1992). Order Number DE93003165. Source: OSTI; NTIS; GPO Dep.

Measurements of the magnetic fluctuations, termed spin-density-wave (SDW) paramagnons, in the nearly antiferromagnetic alloy Cr + 5 at.%V are extended up in energy to about 80 MeV. These fluctuating spin-spin correlations occur at incommensurate positions, corresponding to the SDW wavevector Q. Their characteristic energy is at least an order of magnitude larger than that of the magnetic fluctuations seen in the paramagnetic phase of pure Cr, but their intensity is more than two orders of magnitude smaller. We find that the dynamic susceptibility decreases by about 50% between temperature T = 10K and 300K.

5924 (BNL–48084) **Electron yield XAFS study of evaporated Co/Pd multilayers with various thickness ratios of Co to Pd sublayers: Simulations of the Co K-edge XAFS and fourier transforms.** Choi, M. (Catholic Univ. Medical Coll., Seoul (Korea, Republic of). Dept. of Physics); Joo, J.H.; Kim, S.K.; Kang, J.S.; Lee, Y.P.; Shin, S.C.; Heald, S.M. Brookhaven National Lab., Upton, NY (United States). 1992. 4p. Sponsored by USDOE, Washington, DC (United States); Korea Science and Engineering Foundation (Korea, Republic of). DOE Contract AC02-76CH00016. (CONF-9208160–5: 7. international conference on x-ray absorption fine structure, Kobe (Japan), 23-29 Aug 1992). Order Number DE93003142. Source: OSTI; NTIS; GPO Dep.

Electron-yield XAFS measurements using the NSLS were made on e-beam evaporated Co/Pd multilayers with various sublayer thicknesses and different thickness ratios of Co to Pd sublayers. The Co K-edge and the Pd K-edge XAFS data were obtained for the Co/Pd multilayers with sublayer thicknesses of 3Å/4Å, 15Å/4Å, 3Å/15Å, 2.1Å/13.5Å, and 2.2Å/4.5Å. Fourier transforms of Co K XAFS for most samples show a splitting of major peak, and the magnitude ratio of these split peaks varies systematically with the thickness ratio of the Pd sublayer to the Co sublayer, whereas the Fourier transforms of the Pd K XAFS for the same samples do not show a splitting of peaks. As a preliminary analysis, the Co K XAFS and the split peaks in the Fourier transform for the Co/Pd(3Å/4Å) case were simulated by using the FEFF calculations, and the Co K XAFS and the major peak in the fourier transform for the Co/Pd(15Å/4Å) case were also simulated consistently.

5925 (CONF-8909210–, pp. 35-59) **Electron Compton scattering in the electron microscope.** Schattschneider, P. (Technische Univ., Vienna (Austria)); Pongratz, P. Oak Ridge National Lab., TN (United States). Apr 1990. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter*. 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

The distribution of electron momenta (electron density in momentum representation) of gases can be probed by Compton scattering of either photons (γ-rays or X-rays) or electrons. Recently it has been shown that Compton scattering of electrons is suited to the study of the electron momentum densities of solids on a microscopic scale. This technique, known as ECOSS, Electron Compton Scattering from solids can be done in the electron microscope by Electron Energy Loss Spectroscopy (EELS). The advantages and disadvantages of ECOSS as compared to photon Compton Scattering are discussed. It is shown that ECOSS is a method suitable to obtain information on the ground state wave function in condensed matter. After discussion of inherent approximations, especially the impulse approximation, the reciprocal form factor is introduced. A method is proposed in order to cope with the main difficulty, namely multiple scattering. Important applications of ECOSS are the study of anisotropy of momentum densities; correlation effects of conduction electrons in metals; and charge transfer in alloys.

5926 (CONF-8909210–, pp. 139-151) **Stopping power and ranges in ion implantation.** Bausells, J. (Univ. Autonoma de Barcelona (Spain)). Oak Ridge National Lab., TN (United States). Apr 1990. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain);

4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

Ion implantation is the introduction of atoms into a solid substrate by bombardment of the solid with ions. It has important applications in the fields of materials science and microelectronics, where it is a fundamental technique for semiconductor device fabrication. In most cases successful use of ion implantation requires an accurate knowledge of the implanted ion range distribution inside the target. In recent years, however, high energy ion implantation (usually up to $\approx$ 4 MeV) has been heavily investigated and is expected to play an important role in semiconductor applications. At 4 MeV, boron, phosphorus and arsenic ions, for example, move with velocities of $3.83v_0$ and $1.47v_0$, respectively. As will be discussed in the next section, inelastic stopping power theories in the intermediate velocity region have been using average ion charge states to calculate ion effective charges. Recently, Sols and Flores have obtained the distribution of charge states for light ions in the upper part of the intermediate velocity region. As the implanted ion range distribution is a statistical result, the use of this distributions of charge states instead of average values in the calculation of stopping powers can lead to a different shape in the ion range distributions. In this work the author studies this effect in order to ascertain whether the use of charge state distributions can add new features to ion range distributions in the MeV-energy range of whether its effect is small and need not to be considered.

5927 (CONF-8909210–, pp. 329-341) **Positronium formation and photoemission spectroscopy for surface.** Ishii, Akira (Tottori Univ. (Japan)). Oak Ridge National Lab., TN (United States). Apr 1990. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

Theoretical feasibility study of positronium formation spectroscopy is presented as a complementary spectroscopy to the UV photoemission. Theory is very similar to photoemission if it is recognized that Ps corresponds to a photon, the incident positron corresponds to a time-reversed LEED state. Calculation for Al(100) and Cu(100) showed that positronium formation is quite sensitive to the surface electronic structure. The time-reversed process of positronium formation is also possible to use as a spectroscopy.

5928 (CONF-920672–3) **A perspective on transition temperature and K_{Ic} data characterization.** McCabe, D.E.; Merkle, J.G.; Nanstad, R.K. Oak Ridge National Lab., TN (United States). [1992]. 45p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. From 24. national American Society for Testing and Materials symposium on fracture mechanics; Gatlinburg, TN (United States); 30 Jun - 2 jul 1992. Order Number DE93003088. Source: OSTI; NTIS; INIS; GPO Dep.

Proper identification of transition temperature and shape of the lower-bound (K_{Ic}) fracture toughness curve in the transition range has been a long-term objective. A past practice has been to test a large number of specimens of varying sizes, from 1/2T to 8T compacts, in expectation that size effects and statistical variability of (K_{Jc}) could be resolved empirically. Recently, statistical and constraint-based models have been developed that purport to explain much of what has been seen. Weakest-link theory has been successfully used to predict specimen size effects for the lower part of the transition curve. Constraint-based models of $\beta_c - \beta_{Ic}$ and J_{ssy} (small-scale yield) also can model size effects, but these tend to conflict among themselves with regard to the prediction of full constraint K_{Jc}. All lack potential for defining the absolute lower bound of fracture toughness. Statistically based models have the benefit of quantifying data scatter characteristics and provide a basis for making lower-bound toughness estimates with assigned error estimates. The K_{Jc} data are obtained from small specimens, the size of which is dictated by volume limitations of surveillance capsule size. A basis has been explored for establishing a lower-envelope curve from such data.

5929 (CONF-9206173–10) **Principles of weld solidification and microstructures.** David, S.A.; Vitek, J.M. Oak Ridge National Lab., TN (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 3. international conference on trends in welding research; Gatlinburg, TN (United States); 1-5 Jun 1992. Order Number DE93003012. Source: OSTI; NTIS; GPO Dep.

The integrity and performance of a weld is, to a large extent, controlled by the solidification behavior of the weld metal or fusion zone (FZ). It controls weld-metal microstructure, grain structure, inclusion distribution, porosity, hot-cracking behavior, and, ultimately, weld-meted properties. Weld metal solidification can be understood in the light of recent advances made in solidification theories that relate to castings and rapid solidification of materials. This paper summarizes some of the recent progress made in understanding the weld-pool solidification behavior and its influence on weld-metal microstructures.

5930 (CONF-920762–8) **Phase stability and electronic structure of transition-metal aluminides.** Carlsson, A.E. Forschungszentrum Juelich GmbH (Germany). Inst. fuer Festkoerperforschung. [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-84ER45130. From International conference on the physics of transition metals; Darmstadt (Germany); 20-24 Jul 1992. Order Number DE93003584. Source: OSTI; NTIS; INIS; GPO Dep.

This paper will describe the interplay between die electronic structure and structural energetics in simple, complex, and quasicrystalline Al-transition metal (T) intermetallics. The first example is the $L1_2$-DO_{22} competition in Al_3T compounds. Ab-initio electronic total-energy calculations reveal surprisingly large structural-energy differences, and show that the phase stability of both stoichiometric and ternary-substituted compounds correlates closely with a quasigap in the electronic density of states (DOS). Secondly, ab-initio calculations for the structural stability of the icosahedrally based $Al_{12}W$ structure reveal similar quasigap effects, and provide a simple physical explanation for the stability of the complex aluminide structures. Finally, parametrized tight-binding model calculations for the Al-Mn quasicrystal reveal a large spread in the local Mn DOS behavior, and support a two-site model for the quasicrystal's magnetic behavior.

5931 (CONF-9208129–9) **X-ray examination of Type 310S stainless steel during its oxidation in air at 900°C.** Cavin, O.B. (Oak Ridge National Lab., TN (United States)); Wolf, J.S. Oak Ridge National Lab., TN (United States). [1992]. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Annual Denver x-ray conference; Denver, CO (United States); 3-7 Aug 1992. Order Number DE93003031. Source: OSTI; NTIS; GPO Dep.

Type 310S stainless steel was exposed in air at 900°C and simultaneously examined periodically by X-ray diffraction in an attempt to determine the structural evolution of the compounds formed on its surface. The adherent oxide product was found to be a two-layered scale composed of an inner sesquioxide and an outer spinel layer. Both of these compounds exhibited systematic changes in their unit cell sizes as a function of increasing exposure time at constant temperature. The spinel showed an increase in its lattice parameter while the sesquioxide and stainless steel substrate both had decreases in their parameters proportional to the square root of exposure time. In each of the three phases, the rate of change was constant up to approximately four hours after which the parameters approached a limiting value. Evidence also exists for the presence of at least localized stresses in the scales.

5932 (CONF-921101–10) **Measurement of the critical level of moisture for initiation of water-vapor-induced environmental embrittlement in a Fe_3Al-based alloy.** McKamey, C.G.; Lee, E.H. Oak Ridge National Lab., TN (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Material Research Society fall meeting; Boston, MA (United States); 30 Nov - 5 dec 1992. Order Number DE93004104. Source: OSTI; NTIS; GPO Dep.

Iron aluminides based on Fe_3Al are of interest as structural materials because of their excellent corrosion resistance in many environments. However, studies have shown that one of the major causes of low room temperature tensile ductility, which so far has

limited the use of these alloys, is an environmental reaction involving aluminum in the presence of water vapor. During this reaction, atomic hydrogen is released, moves into the sample ahead of the crack tip during stressing, and causes failure before the true ultimate tensile strength of the material is reached. This reaction is reduced significantly by testing in oxygen or vacuum. In the present study, an Fe_3Al-based alloy was tensile tested as a function of the level of water vapor in the test environment, from a vacuum of 10^{-4} Pa to a water vapor partial pressure of 1330 Pa. The results show that a water vapor level of as low as 133 Pa (1 torr) can result in significant embrittlement. The fracture mode remains transgranular cleavage, but the scale of the cleavage facets changes with the water vapor level.

5933 (CONF-921110–42) **A computational study of the time dependent crack growth process.** Brust, F.W.; Krishnaswamy, P. Battelle, Columbus, OH (United States). [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER14135. From Winter annual meeting of the American Society of Mechanical Engineers (ASME); Anaheim, CA (United States); 8-13 Nov 1992. Order Number DE93004397. Source: OSTI; NTIS; GPO Dep.

Universal studies of creep crack growth for (1) constant load and (2) variable load cases are presented. Results of the constant load cases is compared to experiment. The behavior of displacements and integral creep for fracture parameters are discussed for both load cases. The need for using a constitutive law which can handle cyclic creep is discussed.

5934 (CONF-930360–1) **The application of quality criteria for the prediction of porosity in the design of casting processes.** Viswanathan, S. (Oak Ridge National Lab., TN (United States)); Sikka, V.K.; Brody, H.D. Oak Ridge National Lab., TN (United States). [1993]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 6. modeling of casting, welding and advanced solidification processes conference; Palm Coast, FL (United States); 21-26 Mar 1993. Order Number DE93001719. Source: OSTI; NTIS; GPO Dep.

Solidification parameters calculated from temperature measurements and experimentally determined distributions of porosity in gain- refined Al-4.5% Cu alloy castings are linked to provide quality criteria for the prediction of porosity in the computer-aided design and analysis of casting processes. The quality criteria applicable to a particular casting process are dependent on the thermal conditions and the solidification mode of the alloy. Accordingly, casting processes and alloy types are divided into four groups according to whether porosity distribution is dominated by liquid transport, dendrite structure, or bubble pressure, and a different set of quality criteria is obtained for each group. Results from test castings of Al-4.5% Cu alloy cast in a variety of configurations and mold media are used to develop models and extract quality criteria. The results obtained on Al-4.5% Cu alloy are tested on data on Al-7% Si-0.3% Mg alloy castings reported in the literature. The results show that the quality criteria developed for USSR Cu alloy are also applicable to other alloy systems. The procedure for applying quality criteria for the prediction of microporosity distributions in commercial casting processes is outlined.

5935 (DOE/CE/15503–T2) **The Xu-Tec process of introducing normally solid materials into substrate surfaces: Quarterly technical progress report, July 22, 1992–April 22, 1993.** Xu, Zhong. Plaur Corp., Philadelphia, PA (United States). 21 Dec 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG01-92CE15503. Order Number DE93005124. Source: OSTI; NTIS; GPO Dep.

Most of the initial alloying work has been with the interior of pipe segments. The source electrode, an Inconel 625 rod, was inserted into carbon steel pipe segment cathode. Alloy layers were deposited on the interior surfaces of these segments; maximum thickness (8 μ) was obtained for a potential difference of 200 V.

5936 (DOE/CE/40874–3) **Ferrous scrap preheating system emission characterization test report.** Surface Combustion, Inc., Maumee, OH (United States). 15 Oct 1992. 116p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-89CE40874. Order Number DE93005212. Source: OSTI; NTIS; GPO Dep.

One way to improve economics steel-making is to preheat the scrap metal before placing into an electric arc furnace. This reduces the electric arc furnace energy requirement, thus lowering the power cost and decreasing the melting time. This study uses a free standing preheater that recirculates hot gases to can be safely removed from the scrap during preheating. The test program was conducted to evaluate potential emissions from this scrap preheater and to determine emission control equipment requirements. Two areas of concern were organics and acid gas emissions created by the oils present on the scrap and heavy metal emissions created by the heating the metal. Heavy metal emissions were evaluated for Cr, Ni, Pb, Zn, Cd. Metals were heated to between 800 and 1125 F which is the temperature expected in the preheater. Heavy metal emissions were very low in all cases except Cd. If substantial amounts of Cd. are present in the scrap, it may be necessary to limit the present temperature. It is concluded that it would not be necessary to include auxiliary emission control equipment for the preheater that is to be supplied to preheat stainless steel at the demonstration site.

5937 (DOE/ER/14035–T2) **High pressure heterogeneous catalysis in a low pressure ultrahigh vacuum environment: Summary of progress report, July 1, 1989–December 31, 1992.** Ceyer, S.T. Massachusetts Inst. of Tech., Cambridge, MA (United States). Dept. of Chemistry. [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-89ER14035. Order Number DE93005917. Source: OSTI; NTIS; GPO Dep.

An apparatus was been developed which couples high resolution electron energy loss spectroscopy with molecular beam and scattering techniques. Exposure of Ni(111) to atomic H results in H embedded within the Ni lattice and a monolayer of H adsorbed on the surface. This surface-bound H was removed by an Xe atom beam. Subsequent exposure to CH_4 results in dissociative adsorption, producing adsorbed CH_3 and adsorbed H. Results documents a new mechanism for a surface reaction, a reaction between an adsorbed and a bulk species, and demonstrates the importance of bulk H as a reactant in a heterogeneous catalytic reaction.

5938 (DOE/ER/45188–8) **The roles of slip geometry and hardening behavior in intergranular toughness: Progress report, January 15, 1992–January 15, 1993.** Laird, C.; Bassani, J. Pennsylvania Univ., Philadelphia, PA (United States). Sep 1992. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-85ER45188. Order Number DE93005647. Source: OSTI; NTIS; GPO Dep.

Research is reported in the following areas: cyclic response of polycrystalline Cu, bicrystal experiments and boundary theory, interfacial discontinuities, shear localization in single crystals, coarse slip bands, and macroscopic shear bands.

5939 (DOE/ER/45423–3) **The role of microstructural phenomena in magnetic thin films.** Laughlin, D.E.; Lambeth, D.N. Carnegie-Mellon Univ., Pittsburgh, PA (United States). [1992]. 31p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER45423. Order Number DE93005132. Source: OSTI; NTIS; GPO Dep.

The subject is germane to magnetic recording media. Results during the first 2 years are presented under the following headings: atomic resolution TEM of CoNiCr films; CoNiCr and CoCrTa thin films; development of texture; and CoSm/Cr thin films. The HREM results showed that defects in Co-based films may be responsible for higher coercivity. Findings are presented on the effects of Cr interlayers on the microstructure of the second Co-based film in Co/Cr/Co/Cr multilayer films. Proposed research plans are outlined.

5940 (DOE/ER/45454–T1) **A study of transient particle coarsening: Annual performance report and planned research.** Hoyt, J.J. Washington State Univ., Pullman, WA (United States). Dept. of Mechanical and Materials Engineering. 19 Oct 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG06-91ER45454. Order Number DE93005676. Source: OSTI; NTIS; INIS; GPO Dep.

Efforts were concentrated on numerically modeling the time-dependent particle coarsening (Ostwald ripening) process. Four models were included: Lifshsitz-Slyozov-Wagner, Brailsford and Wynblatt, Marqusee and Ross, and Marder. The simulations monitored the particle size distribution (PSD) as a function of time; initial PSDs were derived from classical nucleation theory. The ripening kinetics can be represented as a plot of the second moment of normalized PSD vs time. A geometric correction factor is discussed. Future research is planned on Al-Li.

5941 (DOE/ID/12624–1) **Collection and conversion of silicon furnace waste gas into higher value products: Phase 2, Experimentation: Final report.** Dosaj, V.D. Dow Corning Corp., Midland, MI (United States). Feb 1992. 99p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-87ID12624. Order Number DE93000906. Source: OSTI; NTIS; GPO Dep.

Experimental studies and verification of the closed furnace concept for smelting silicon and of conversion of the off-gas to methanol are the basic elements of this Phase II effort. The more significant benefits of a closed furnace over a conventional open furnace were found to include: 1. Total energy savings of about 10 kWh/lb silicon are feasible considering the embodied energy; 2. Silicon yield is increased to about 90% from typically 80%; 3. Electrode consumption is reduced about 33%; 4. Carbon losses are reduced, thus requiring 3–5% less carbon; 5. The off-gas, containing 52% of the furnace energy input, can be collected; 6. Operator safety is improved by reducing exposure to hazards; and 7. Major source of SiO fume and CO_2 gas pollution is virtually eliminated. Projections estimate the energy savings to be about 86×10^{12} Btu/yr for year 2010 assuming a total of 57 closed furnaces (20 MW each). Eighteen samples of off-gas were taken from closed furnace feed runs, with four separate stock combinations, for analysis and assessment of conversion to methanol. Nitrogen was used as a furnace inerting blanket in concentrations from about 45 to 70%. Heat of combustion of the off-gas, excluding the nitrogen component, was typically about 375 Btu/ft. The off-gas samples were evaluated for methanol conversion in 15–20 hour tests using a laboratory high pressure reactor and a commercial methanol synthesis catalyst. The role of potential sulfur impurities, which could poison the catalyst, was carefully monitored.

5942 (DOE/ID/12869–T1) **Cupola modeling research: Phase 2 (Year one), Final report.** American Foundrymen's Society, Des Plaines, IL (United States). 20 Nov 1991. 287p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC07-89ID12869. Order Number DE93005813. Source: OSTI; NTIS; GPO Dep.

Objective was to develop a mathematical model of the cupola furnace (cast iron production) in on-line and off-line process control and optimization. In Phase I, the general structure of the heat transfer, fluid flow, and chemical models were laid out, providing reasonable descriptions of cupola behavior with a one-dimensional representation. Work was also initiated on a two-dimensional model. Phase II was focused on perfecting the one-dimensional model. The contributions include these from MIT, Michigan University, and GM.

5943 (DOE/NE/37963–21) **Embrittlement studies in austenitic stainless steels: FY89, Annual progress report, October 1988–September 1989 and CY89 third quarter report.** Atteridge, D.G. (Oregon Graduate Inst. of Science and Technology, Beaverton, OR (United States)); Wood, W.E.; Bruemmer, S.M. Oregon Graduate Inst. of Science and Technology, Beaverton, OR (United States). [1989]. 102p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-86NE37963. Order Number DE93005059. Source: OSTI; NTIS; GPO Dep.

Potential causes for high strain rate induced embrittlement in Type 304 and 316 austenitic SSs have been classified as grain boundary carbide precipitation; grain boundary P segregation; grain boundary martensite formation; and sigma phase precipitation. The impact energy of heats containing a substantial amount of C decreases rapidly as a result of sensitization heat treatment. Temperatures below or above this result in very little embrittlement. Intergranular embrittlement can be produced solely by grain boundary carbide precipitation. Phosphorus played only a secondary role, if any, in the development of IG fracture. No formation of grain boundary a thermal martensite was observed; its presence at the grain boundaries is not required to cause a massive drop in impact toughness. Distribution and morphology of grain boundary carbide precipitates significantly affects the impact toughness of the steels. Carbides formed at high aging temperatures are coarser and the impact drop is not as pronounced as at lower temperatures. Precipitation of sigma from retained delta-ferrite takes place at very short aging times and severely degrade the impact toughness. A maximum of 10% P for 316 SS and 20% P for 304 SS (monolayer coverage) was observed at grain boundaries, not enough to cause embrittlement.

5944 (DOE/NE/37963–22) **Deformation induced microstructural and microchemical changes during thermomechanical treatment: Final report, FY91 annual progress report, October 1, 1991–September 30, 1991 and third quarter progress report, CY91.** Atteridge, D.G. (Oregon Graduate Inst. of Science and Technology, Beaverton, OR (United States)); Wood, W.E.; Bruemmer, S.M. Oregon Graduate Inst. of Science and Technology, Beaverton, OR (United States). [1992]. 75p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-86NE37963. Order Number DE93005060. Source: OSTI; NTIS; INIS; GPO Dep.

An analytical model has been developed for predicting thermomechanical effects on the development of grain boundary chromium depletion in austenitic stainless steel as a first step in predicting intergranular stress corrosion cracking susceptibility. Model development and validation is based on sensitization development analysis of over 30 Type 316 and 304 stainless steel heats. The data base included analysis of deformation effects on resultant sensitization development. Continuous cooling sensitization behavior is examined and modeled with and without strain. Gas tungsten arc girth pipe weldments are also characterized by experimental measurements of heat affected zone temperatures, strains and sensitization during/after each pass; pass by pass thermal histories are also predicted. The model is then used to assess pipe chemistry changes on chromium depletion changes.

5945 (ETDE/JP-mf–93753763, pp. 386-403) **Superconductive materials.: Processing technology and measurement of characteristics.** Kumakura, H. (National Research Institute for Metals, Tsukuba (Japan)). Cryogenic Association of Japan, Tokyo (Japan). [1991]. 606p. (In Japanese). In *Proceedings of the 1st-4th cryogenic engineering summer seminar (1988-1991).* Order Number DE93753763. Source: OSTI; NTIS (US Sales Only).

Together with the characteristics of superconductive materials, the present report explained the wire rod processing technology and methods of measuring the characteristics. Easy to directly build up to the wire rod, the NbTi alloy excels in mechanical characteristics and is put inexpensively to practical use. The critical temperature is 8 to 10K and the upper critical magnetic field is 10 to 12tesla. If the pinning is put out of magnetic flux lines, it moves them, and causes a heightening in temperature and degradation in superconductive characteristics. To prevent it, building up to a multi-conductor wire rod is made by inserting an ingot of NbTi, after melted by electron beam, into a hole drilled in an oxygen free copper rod and processing it to make its diameter small. Many thus processed ingots being bundled, repetition is made of building up to the wire rod. Though so brittle as not to be directly processable, the Nb_3Sn and V_3Ga considerably excel the NbTi in superconductive characteristics. The Nb_3Sn is built up to the wire rod by inserting a Nb rod into a hole drilled in a Cu-Sn alloy rod, processing the thus prepared combined body to the wire rod in a cold ambience and thermally treating it. As catalytic only, the Cu does not enter as a constituent element of compound between metals. High in heterogeneity and short in coherence length, the high temperature oxide superconductor is unknown in effectiveness of pinning the magnetic flux lines so that its being built up to the wire rod is being gropingly put to practical use. As a method of building up to the wire rod, there are processing with wrapping, direct condensation, gaseous phase and other methods. The report also explained the technology of measuring thesuperconductive characteristics. 53 refs., 14 figs., 2 tabs.

5946 (ETDE-mf–93742728) **Controlled laser hardening by online process control. Final report.** Bergmann, H.W.

Erlangen-Nuernberg Univ., Erlangen (Germany). Lehrstuhl fuer Werkstoffwissenschaften 2; Bundesministerium fuer Forschung und Technologie, Bonn (Germany). 10 Jan 1991 61p. (In German). Contract BMFT 13N5445. Order Number DE93742728. Source: OSTI; NTIS (US Sales Only).

The report gives one way for the analytical solution of the heat conduction equation in combination with a moving laser beam and solutions for the stationary and nonstationary state. A pyrometric process control is described and results obtained from laser hardening of different tool steels are presented. The results achieved within the project open the possibility of online simulated and online controlled laser hardening. These points are very important to introduce laser hardening into production. (orig.) With 18 refs., 3 tabs., 45 figs.

5947 (ETDE-mf–93744509) **Preliminary tests for the testing phase of the demonstration plant for low-waste zinc electroplating in Manila. Final report.** Danninger, W. Gesellschaft fuer Technische Studien, Entwicklung, Planung mbH (SEP), Muenchen (Germany); Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Jul 1986 30p. (In German). Contract BMFT 01VQ8510. Order Number DE93744509. Source: OSTI; NTIS (US Sales Only).

Within the scope of the project 'Engineering and Testing of a low-waste Zinc Electroplating Plant in the Philippines, Phase II' FKZ 01 VQ 122 at present a demonstration plant for low-waste zinc electroplating is being built in the vicinity of Manila. The present project deals with the performance of preliminary tests for the testing program planned for the beginning of next year. In order to ensure this testing phase and to guarantee that the plant, considered for demonstration and training purposes, remains efficient also after the German operators have left, a philippine chemist and a technician, the future plant leader, have been instructed in the applied technology of the plant from September 1985 to January 1986. Together with these Philippine specialists particularities of the technique and layout of the plant, its procedure, the used chemicals as well as measures for quality control and disposal of the waste material were elaborated on plants equipped with recycling measures running in German, and laid down in a 'manual'. (orig.).

5948 (ETDE-mf–93750839) **Corrosion tests of high-alloy stainless steels and nickel alloys in natural sea water under flowing conditions. Final report.** Metallgesellschaft AG. Bericht des Zentrallaboratoriums. Altpeter, E. Metallgesellschaft AG, Frankfurt am Main (Germany); Bundesministerium fuer Forschung und Technologie, Bonn (Germany). 21 Apr 1992 131p. (In German). Order Number DE93750839. Source: OSTI; NTIS (US Sales Only).

As a result of the corrosion tests a clear difference in the corrosion resistance of stainless steels/nickel alloys as a function of their Cr, Mo and Ni content has been found. Corrosion tests with natural sea water should confirm these results. The MPA/FH Hamburg (Technical University Hamburg, Material Inspection Institute) (see project H 7.1/11B) has built a test loop in Helgoland for this purpose. This installation is operating with natural sea water circulation. The selected materials 317 LN, 904 L, 926, alloy 28, alloy G-3, alloy 625 and alloy C-276 have been tested for one year under flowing (1 m/s) and quasi standstill conditions (0.1 m/s) for pitting, crevice and stress corrosion cracking. Tube and sheet samples with and without welding seams have been exposed at temperatures of 50 to 70deg C. In addition alloy 59 has been tested for one year and alloy 31 and alloy 24 for only 9 months as sheet samples under quasi standstill conditions at 70deg C. The influence of low, medium and very high flow velocities (60 to 2000 min^{-1}) was proven in laboratory tests with a rotating disc electrode under potentiostatic conditions (U = 0.5 V_H) in artificial sea water at temperatures of 50, 70 and 90deg C and emphasizing on the materials 926, alloy 28 and alloy 625. The nickel alloys 625, alloy C-276 and alloy 59 have proven to be corrosion resistant in natural sea water at 50deg C and 70deg C under all here tested conditions. If exposed to unfavorable crevice corrosion conditions, crevice corrosion already has been found at temperatures of 50deg C on the stainless steels 317LN and 904L. Among the tested stainless steels, the one with the highest Mo content, 926, shows the highest crevice corrosion resistance. Stainless steels show a tendency to be less resistant to crevice corrosion in natural sea water than in artificial sea water. (orig./MM) With 14 refs., 13 tabs., 89 figs.

5949 (FhG-IWM-W–6/91) **Connection between crack propagation energy and J crack resistance curves.** Memhard, D.; Klemm, W. Fraunhofer-Institut fuer Werkstoffmechanik, Freiburg im Breisgau (Germany). Dec 1991. 62p. (In German). Order Number DE93742731. Source: OSTI; NTIS (US Sales Only).

For pressure vessel steel 22 Ni Mo Cr 3 7, crack initiation and crack growth are first examined on CT samples and SENT samples. For the CT samples, crack resistance curves are determined based on the J integral concept by the conventional process (12), while for the SENT samples, the J integral is determined from numerical simulation. The crack propagation energies are determined experimentally and numerically on large tensile disks and are related to the J integral concept. (orig.).

5950 (FhG-IWM-W–7/91) **Analysis and further development of fracture mechanics failure concepts. Main topic: Application of the J integral concept and its extensions on component-relevant situations. Final report.** Schmitt, W.; Brocks, W. Fraunhofer-Institut fuer Werkstoffmechanik, Freiburg im Breisgau (Germany); Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Dec 1991. 42p. (In German). Contract BMFT 1500488B8. Order Number DE93744378. Source: OSTI; NTIS (US Sales Only); INIS.

In many investigations with increasingly complex conditions of use, the concepts of elastic/plastic fracture mechanics and particularly the J integral concept for the quantitative evaluation of failure behaviour have proved successful. This was proved in this project by largely clearing up the effects of constraint in the environment of cracks and the use of the J integral concept with superimposed thermal and mechanical stresses which can occur in thermal shock transients important for safety analysis. In continuing the investigations of dynamic J_R curves, it was confirmed that the tendency to form auxiliary cracks and therefore to raise the crack resistance curve increases with the stress parameters and also with the size of the sample. Here and in investigations on the effect of large crack widths on quickly loaded disks with side cracks caused some difficulties. The improvement of the J integral calculation aimed at by correction terms could not be satisfactorily achieved. One way out is the crack energy to describe great extensions of cracks. (orig.).

5951 (GKSS–92/E/18) **Finite element analyses for evaluating stresses of a longitudinal weld seam with undercuts and an imperfection by roofing at a cylindrical vessel under internal pressure.** Dietrich, R.A. (GKSS, Geesthacht (Germany). Inst. fuer Anlagentechnik); Schoenfeld, W. GKSS-Forschungszentrum Geesthacht GmbH, Geesthacht-Tesperhude (Germany). 1992. 24p. (In German). Order Number DE93744884. Source: OSTI; NTIS (US Sales Only).

Linear and nonlinear finite element analyses are discribed for evaluating the stresses of a welded joint at a cylindrical vessel, in which connection it is assumed, that the edges of the weld seams have imperfections by roofing and undercuts. In these analyses the imperfection by roofing, the shape of the welded double joint and the undercuts are simulated by a finite element mesh. The numerical results indicate, that the imperfection by roofing in the area of welded joint leads to great stress elevations with large plastic zones. (orig.) With 13 figs.

5952 (INIS-BR–2952) **Effect of the hydrogen charging of AISI 316 stainless steel from solutions containing $As_2 O_3$.** Brito, S.D. de. Universidade Federal, Rio de Janeiro, RJ (Brazil). Coordenacao dos Programas de Pos-graduacao de Engenharia. 1973[79] (In Portuguese). Order Number DE93608937. Source: OSTI; NTIS (US Sales Only); INIS.

The hydrogen charging of AISI 316 stainless steel has turned unstable the austenitic structure which partially decomposes into two phases: ϵ (hexagonal close packed) and α' (body centered cubic). A 1 N $H_2 SO_4$ solution was used as electrolyte, with varying concentrations of $As_2 O_3$ (0, 1, 5 and 100 mg/l) for a single constant applied current density (i_c = 0,22 A/cm^2). It was observed that a smaller austenitic grain as well as a larger hydrogen charging time, improve the phase transformation. It was established that

the order in which the transformation products of the austenite appear through hydrogen charging follows the sequence: $Y \rightarrow Y\text{-bar} + \epsilon \rightarrow Y + \epsilon + \alpha'$, although there is still some doubt about the equivalent transformation order by plastic deformation. (author).

5953 (INIS-BR–2994) **Study on kinetic of strain-aging in zircaloy-4.** Gomes, P.A. Minas Gerais Univ., Belo Horizonte, MG (Brazil). Dept. de Engenheria Metalurgica. 1977[82] (In Portuguese). Order Number DE93608948. Source: OSTI; NTIS (US Sales Only); INIS.

The strain-aging in zircaloy-4 has been investigated in this work and a study of the general problems involving this phenomenon has been realized in Zirconium and its alloys. It has been verified that a yield point appears in the Zircaloy-4, when it is submitted to strain-aging treatment between the temperatures 200^0 C and 400^0 C. (author).

5954 (INIS-BR–2995) **Analysis of the tensile behaviour of zircaloy-4 in the region of dynamic strain aging.** Dellaretti Filho, O. Minas Gerais Univ., Belo Horizonte, MG (Brazil). Dept. de Engenheria Metalurgica. 1974[131] (In Portuguese). Order Number DE93608949. Source: OSTI; NTIS (US Sales Only); INIS.

An analysis of the tensile behavior of Zircaloy 4, centering around the influence of dynamic strain aging and strain rate history, is presented. This analysis is based on techniques introduced by Jaoul-Crussard and Reed-Hill. An attempt is also made to assess the experimental errors that influence these methods. (author).

5955 (INIS-BR–2996) **Study of necking stability in tension test of zircaloy-2, on range from 170 ^{0} C to 620 ^{0} C.** Okuda, M.Y. Minas Gerais Univ., Belo Horizonte, MG (Brazil). Dept. de Engenheria Metalurgica. 1975[172] (In Portuguese). Order Number DE93608950. Source: OSTI; NTIS (US Sales Only); INIS.

The objective of this work is to study necking behavior of Zircaloy-2 in a tension test in which the temperature range varies from 170^0 C to 620^0 C by means of a model. This model provides strain rate variations in the beginning of necking and the parameters in the /necking stability. A new parameter Ψ is presented which permits necking /stability description in metals by means of a simple tension test. It is also proceeded a behavioral study of ϵ versus ϵ curve after necking formation. (author).

5956 (INIS-BR–3066) **Study of the experimental parameters associated to the determination of residual macro stresses in stainless steel tubes, through x-ray diffraction method.** Guimaraes, L.R. Instituto de Pesquisas Energeticas e Nucleares (IPEN), Sao Paulo, SP (Brazil). 1990[92] (In Portuguese). Order Number DE93608951. Source: OSTI; NTIS (US Sales Only); INIS.

The basic principles related to the determination of residual macro stresses by X-rays diffractometry are present, whereas different techniques associated with the respective experimental errors are discussed. The residual stresses in two 304 L stainless steel tubes were measured using three models of diffractometers, Rigaku SG-8, Jeol JDX-11PA and Rigaku Strainflex. The measured values of stresses as well as the reproducibilities are examined. The suitability of peak location method, by fitting three data points to the parabolic function, is discussed through values of position and intensity obtained by two of the above diffractometers. (author).

5957 (INIS-mf–13204, pp. 161-164) **Neutron irradiation effects on inelastic and mechanical properties in Al-Mg-Si alloys.** Ghilarducci, A.A. (Comision Nacional de Energia Atomica, San Carlos de Bariloche (Argentina). Centro Atomico Bariloche); Carreno Morelli, E.; Urreta de Pereyra, S.E. Comision Nacional de Energia Atomica, Buenos Aires (Argentina); International Atomic Energy Agency, Vienna (Austria); Secretaria de Ciencia y Tecnica, Buenos Aires (Argentina). 1990. [368] (CONF-900739–: 4. Latin American workshop on plasma physics, Buenos Aires (Argentina), 16-27 Jul 1990). In *Fourth Latin-American workshop on Plasma Physics (held in) Buenos Aires, Argentina, 16-27 Jul 1990. Contributed papers.* Order Number DE92635466. Source: OSTI; NTIS (US Sales Only); INIS.

In the present work, the effect of small doses of neutron irradiation on mechanical behaviour is correlated with changes found in the internal friction spectrum of their alloys after irradiation. As the mechanisms contributing to this spectrum have been previously investigated, these results are applied to evaluate microstructural changes due to neutron irradiation. (Author).

5958 (INIS-mf–14096) **Chemical resistance of the stainless REMANIT steels.** Thyssen Edelstahlwerke AG. Druckschrift. Thyssen Edelstahlwerke AG, Krefeld (Germany); Thyssen Edelstahlwerke AG, Witten (Germany). Feb 1992 53p. (In German). Order Number DE93742647. Source: OSTI; NTIS (US Sales Only); INIS.

The leaflet contains tables showing the corrosion behaviour of the REMANIT steels in various media, as e.g. in acids, brines, salty solutions, or in organic environments. The data given include information on the composition and concentration of the attacking agent, and on temperatures. The documentation is intended to serve as a guide for selecting the suitable steel quality for intended applications. (MM).

5959 (INIS-SU–322) **Optical properties and defect structure of crystalline bodies.** Gindin, I.A.; Chirkina, L.A.; Metolidi, Eh.N. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (Russian Federation). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i. 1989. [29] (In Russian). Order Number DE93608959. Source: OSTI; NTIS (US Sales Only); INIS.

The main features of optical characteristics of ion, semiconductor and metal crystals have been analysed. It is shown that various types of defects resulting from mechanical and thermal action have significant effect on optical properties of materials with various types of interatomic interaction. The main regularities and differences in defect structure effect on optical properties of ion, semiconductor and metal crystal are detected. 52 refs.; 17 figs.

5960 (INIS-SU–325/A) **Superconductivity of high-dispersion beryllium condensates.** Semenenko, E.E.; Tutov, V.I. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (Russian Federation). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i. 1990. [61] (In Russian). Order Number DE93608958. Source: OSTI; NTIS (US Sales Only); INIS.

Review of the papers on study of superconducting (T_c) and electrophysical properties of high-dispersion beryllium condensates permits to conslude that superconducting layers are in metastable fine-crystalline modification stabilized by low sized (3 nm). Amorphization and availability of impurities suppress superconductivity. Such notion permits to explain all contradictory data on superconducting, electron and structural study of high-dispersion beryllium condensates. 82 refs.; 22 figs.; 3 tabs.

5961 (JAERI-M–92-086) **DBTT measurement by use of small punch (SP) test.** Suzuki, Masahide (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Fukaya, Kiyoshi; Nishiyama, Yutaka; Eto, Motokuni. Japan Atomic Energy Research Inst., Tokyo (Japan). Jun 1992. 50p. Order Number DE93753188. Source: OSTI; NTIS; INIS.

Microhardness and SP tests were conducted to improve the reliability of ductile-brittle transition temperature (DBTT) shift evaluation caused by aging (thermal aging, neutron irradiation, cold rolling) using several model alloys (Fe-0.15C alloys and 2 1/4 Cr-1Mo steels). Although evaluation of DBTT by the SP test was overall good, intergranular brittleness could not be detected by SP DBTT measurement only. By combining other measurements like fractographic observation, however, material degradation can be evaluated more properly. (author).

5962 (KFK–4935, pp. 129-137) **Stress corrosion of type 304 stainless steel in molten NaOH/Ha mixtures.** Menken, G. (Interatom, Bergisch Gladbach (Germany)); Dietz, W. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Materialforschung. Dec 1991. (CONF-9106290–: Properties of structural materials in liquid metal environment, Karlsruhe (Germany), 18-20 Jun 1991; IWGFR–84). In *Properties of structural materials in liquid metal environment. Proceedings.* 211p. Order Number DE92009398. Source: OSTI; NTIS (US Sales Only); INIS.

NaOH may be formed under special conditions on components during the ingress of water vapour in a sodium system in the cover

gas region. Experiments were performed in order to quantify the corrosion effects, which were produced in stressed samples due to the reaction with a limited amount of dry NaOH on the surface during the exposure under sodium vapour conditions in the temperature range between 350deg C and 560deg C. The experiments showed that the amount of NaOH and the duration of exposure was important for the corrosion effects. The highest effects were found, when the H_2/H_2O containing gas reacts near the sodium level at low temperatures above the melting point of NaOH (ca. 320deg C), i.e. when a consumption of NaOH either by evaporation or by the reaction with the metal was negligible. If there exist a sodium vapour pressure in equilibrium with 450deg C, NaOH surface films are not stable in the presence of 50 vpm H_2O and corrosion reactions are limited. At much higher temperatures of 560deg C any NaOH films are removed either by evaporation or by a surface reaction and even at 50 vpm H_2O the formation of new NaOH was not possible if sodium at 560deg C was available. (orig.).

5963 (KFK–4935, pp. 205-207) **Crack initiation (J-Δa curves) in liquid sodium on type 304 SS after previous creep damage.** Huthmann, H. (Interatom GmbH, Bergisch Gladbach (Germany)); Gossmann, O. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Materialforschung. Dec 1991. (CONF-9106290–: Properties of structural materials in liquid metal environment, Karlsruhe (Germany), 18-20 Jun 1991; IWGFR–84). In *Properties of structural materials in liquid metal environment. Proceedings.* 211p. Order Number DE92009398. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. STAINLESS STEEL-304/crack propagation; STAINLESS STEEL-304/sodium; LIQUID METALS; SODIUM; TEMPERATURE RANGE 0400-1000 K; CREEP

5964 (KFK–5019) **ZERBERUS - the code for reliability analysis of crack containing structures.** Cizelj, L. (Reactor Engineering Div., Jozef Stefan Inst., Ljubljana (Slovenia)); Riesch-Oppermann, H. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Materialforschung; Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Kernfusion. Apr 1992. 101p. Order Number DE93744406. Source: OSTI; NTIS (US Sales Only); INIS.

Brief description of the First- and Second Order Reliability Methods, being the theoretical background of the code, is given. The code structure is described in detail, with special emphasis to the new application fields. The numerical example investigates failure probability of steam generator tubing affected by stress corrosion cracking. The changes necessary to accommodate this analysis within the ZERBERUS code are explained. Analysis results are compared to different Monte Carlo techniques. (orig./HP).

5965 (KFTI–90-18) **Influence of dislocation structure and impurities on void lattice formation in crystals under irradiation.** Dubinko, V.I. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. [13] Order Number DE93608977. Source: OSTI; NTIS (US Sales Only); INIS.

The void ordering under irradiation in simple cubic, bcc, fcc and hcp-crystals is considered within the framework of the dislocation model of void lattice formation based upon the absorption of perfect interstitial loops by voids. The ordering criterion is derived taking into account not only perfect loopd but Frank sessile loops and straight dislocations as well. Analytical dependence of void lattice parameters on the concentration of the loop nucleation sites is derived. Impurities are shown to stimulate or prevent void ordering depending on their influence on the loop nature. Finally, a mechanism of loop-punching from submicroscopic overpressurized gas bubbles is considered as a possible source of perfect loops which could induce the swelling saturation and void ordering in fcc metals with low stacking fault energy. 15 refs.; 3 figs.

5966 (KRUPP-VDM-UB–12/92) **Manufacture and qualification of hot roll-clad composites with nickel base cladding material for use in flue gas desulphurization plants. Final report.** Kirchheiner, R.; Stenner, F. Krupp-VDM AG, Werdohl (Germany); Bundesministerium fuer Forschung und Technologie, Bonn (Germany). 16 Mar 1992. 72p. (In German). Contract BMFT 11B6073. Order Number DE93742642. Source: OSTI; NTIS (US Sales Only).

Flue gas desulphurization plants (FGD), which have been required by law since 1983, mainly apply wet scrubbing techniques. The chemical reactions taking place in those plants lead to extremely corrosive situations. Unprotected carbon steel surfaces or organic based anticorrosive systems are extremely affected after being in operation for only a few years. NiCrM alloys applied by the chemical industry in comparable situations have proved their efficiency for decades. When such massive components are newly built in FDGs, economic aspects require the use of those NiCrMo alloys in clad form. Within the frame of this project tests included the manufacture of hot roll-clad composites comprising cladding materials of the type NiMo16Cr15W (2.4819) and NiCr21Mo14W (2.4602) on the base steel RST 37-2. Large-sized sheets (10000 x 2000 x 10+2 mm) were made by means of an optimized cladding technique. The behaviour of the cladding material in case of uniform and local corrosion exposure was examined in standard laboratory tests. An increased susceptibility to intercrystalline corrosion was not detected, according to the excellent microstructure. Further laboratory tests under simulated FGD conditions and exposure tests in FGDs in operation permitted the transfer of those positive test results to practical work. The same applies without limitation to the joint-welded state with similar filler material of clad a comparable chemical composition. With respect to their technological behaviour the new hot roll-clad composites correspond to that of solid sheets of NiCrMo alloys; therefore they are qualified for use in flue gas desulphurization plants. (orig./BBR) With 32 refs., 13 tabs., 29 figs.

5967 (LA-UR–92-3281) **Target penetrator interaction: 70 volume percent tungsten-30 volume percent uranium penetrator material.** Dunn, P.S.; Baker, B.D. Los Alamos National Lab., NM (United States). [1992]. 7p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9211136–1: International tungsten symposium, Washington, DC (United States), 16-18 Nov 1992). Order Number DE93003742. Source: OSTI; NTIS (US Sales Only); GPO Dep.

A 70 volume percent tungsten/30 volume percent uranium penetrator material was fabricated by infiltrating uranium into a porous tungsten preform. This material essentially represented a matrix substitution of uranium for nickel and iron in a conventional tungsten heavy alloy. These as-cast materials were ballistically compared with conventional U-3/4 Ti material at Los Alamos and the US Army Ballistics Research Laboratory (BRL). While the mechanical properties of the as cast/infiltrated material were inferior to those of the U-3/4 Ti, both materials were ballistically equivalent. It is believed that the ballistic performance of U-3/4 Ti is related to early localized failure caused by adiabatic shear. The target post-mortem evaluation was undertaken to determine if the same mechanism applies to the uranium-tungsten penetrator material. Areas of analysis included the penetration channels in semi-infinite rolled-homogenous armor (RHA), and residual penetrator tubes and penetrator stubs from the BRL target. Results from the uranium-tungsten material were then compared to similar ballistic tests using U-3/4 Ti. Observations in the uranium-tungsten material indicate that localized failure in the uranium matrix, similar to U-3/4 Ti, was the dominant mechanism for penetrator performance.

5968 (LA-UR–92-3406) **Excimer laser surface modification: Process and properties.** Jervis, T.R. (Los Alamos National Lab., NM (United States)); Nastasi, M.; Hirvonen, J.P. Los Alamos National Lab., NM (United States). [1992]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9211127–1: Materials Research Society (MRS) meeting, Pittsburgh, PA (United States), 3 Nov - 4 dec 1992). Order Number DE93003726. Source: OSTI; NTIS; GPO Dep.

Surface modification can improve materials for structural, tribological, and corrosion applications. Excimer laser light has been shown to provide a rapid means of modifying surfaces through heat treating, surface zone refining, and mixing. Laser pulses at modest power levels can easily melt the surfaces of many materials. Mixing within the molten layer or with the gas ambient may occur, if thermodynamically allowed, followed by rapid solidification. The high temperatures allow the system to overcome kinetic barriers found in some ion mixing experiments. Alternatively, surface

zone refinement may result from repeated melting-solidification cycles. Ultraviolet laser light couples energy efficiently to the surface of metallic and ceramic materials. The nature of the modification that follows depends on the properties of the surface and substrate materials. Alloying from both gas and predeposited layer sources has been observed in metals, semiconductors, and ceramics as has surface enrichment of Cr by zone refinement of stainless steel. Rapid solidification after melting often results in the formation of nonequilibrium phases, including amorphous materials. Improved surface properties, including tribology and corrosion resistance, are observed in these materials.

5969 (LA-UR–92-3490) **Optical constants from mirror reflectivities measured at synchrotrons.** Blake, R.L. (Los Alamos National Lab., NM (United States)); Davis, J.C.; Burbine, T.H.; Graessle, D.E.; Gullikson, E.M. Los Alamos National Lab., NM (United States). [1992]. 5p. Sponsored by USDOE, Washington, DC (United States); National Aeronautics and Space Administration, Washington, DC (United States). DOE Contract W-7405-ENG-36 ;AC03-76SF00098. (CONF-920792–43: Society of Photo-Optical Instrumentation Engineers (SPIE) international symposium on optical applied science and engineering, San Diego, CA (United States), 19-24 Jul 1992). Order Number DE93003751. Source: OSTI; NTIS; INIS; GPO Dep.

Improved mirror reflectivity measurement techniques have been introduced to permit more accurate determinations of optical constants δ and β in the complex index of refraction $n = 1 - \delta - i\beta$ over the energy range 50 to 5000 eV. When the density has been determined by x-ray or other means, one can calculate the real and imaginary parts f′ and f″, of the complex atomic scattering factor $f = f_o + f' + if''$ from δ and β. Preliminary results are given for the Ni LIII edge around 852 eV, and the Au M edge region from 2150 to 3500 eV. Since these are the first experimental evaluations of δ for these element edges, they are compared with appropriate reservations to semi-empirical tabulations. There is much potential for this technique applied to synchrotron sources.

5970 (LA-UR–92-3491) **Optical constants and scattering factors from reflectivity measurements: 50 eV to 5 keV.** Blake, R.L. (Los Alamos National Lab., NM (United States)); Davis, J.C.; Graessle, D.E.; Burbine, T.H.; Gullikson, E.M. Los Alamos National Lab., NM (United States). [1992]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9208184–1: Anomalous scattering international conference, Malente (Germany), 17-21 Aug 1992). Order Number DE93003750. Source: OSTI; NTIS; INIS; GPO Dep.

An improved reflection technique has been introduced to permit more accurate measurements of material optical constants δ and β, the density ρ, and from these the atomic scattering factors f′ and f″. Regions of normal and anomolous dispersion can be measured with resolving power 1000 or larger using a portable reflectometer that is moved to any of three beamlines at NSLS or two at CHESS. Herein the reflectometer and measurement techniques are described together with sample characteristics and preliminary results for the Ni LIII edge and the M edges of Au, Pt, and Ir. The primary accuracy limiting factors are density determination, accumulation of surface oxides or carbonaceous deposits, and synchrotron orbit stability. Each sample must be prepared for the specific energy range to be measured so that model fitting routines have the minimum possible number of free variables.

5971 (LA-UR–92-3682) **Fracture at Cu/sapphire interfaces.** Reimanis, I.E. (Los Alamos National Lab., NM (United States)); Dalgleish, B.J.; Trumble, K.P. Los Alamos National Lab., NM (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-921128–2: Ceramic science and technology congress and exposition, San Francisco, CA (United States), 1-4 Nov 1992). Order Number DE93003816. Source: OSTI; NTIS; GPO Dep.

Crack propagation at diffusion bonded Cu/α-Al_2O_3 interfaces was studied in situ in the optical microscope using a delamination specimen geometry. Chemical reactions between Cu and $A1_2O_3$ during diffusion bonding produce discrete interphases at the interface which effect the fracture behavior. The measured fracture energies depends on the thickness of the Cu layer in the sandwich geometry: $\Gamma_i \sim 110$ J/m^2 for 130 μm Cu thicknesses while $\Gamma_i \sim 70$ J/m^2 for the 25 μm Cu thicknesses. Considerable roughening through crack face bridging by the discrete interphases is observed. Two different models which describe the toughening are discussed.

5972 (LA-UR–92-3715) **The behavior of intermetallic compounds at large plastic strains.** Gray, G.T. III (Los Alamos National Lab., NM (United States)); Embury, J.D. Los Alamos National Lab., NM (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-921101–5: Material Research Society fall meeting, Boston, MA (United States), 30 Nov - 5 dec 1992). Order Number DE93003820. Source: OSTI; NTIS; GPO Dep.

Much effort has been devoted to the study of ordered materials at modest plastic strains and the problem of premature failure. However by utilizing stress states other than simple tension it is possible to study the deformation of intermetallic compounds up to large plastic strains and to consider the behavior of these materials in the regime where stresses approach the theoretical stress. The current work outlines studies of the work hardening rate of a number of titanium and nickel-based intermetallic compounds deformed in compression. Attention is given to the structural basis of the sustained work hardening. The large strain plasticity of these materials is summarized in a series of diagrams. Fracture in these materials in compression occurs via catastrophic shear at stresses of the order of E/80 (where E is the elastic modulus).

5973 (LBL–32810) **Micromechanics of shear banding.** Gilman, J.J. Lawrence Berkeley Lab., CA (United States). Aug 1992. 37p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-9209240–3: Society of Engineering Science (SES) technical meeting, San Diego, CA (United States), 14-16 Sep 1992). Order Number DE93002568. Source: OSTI; NTIS; GPO Dep.

Shear-banding is one of many instabilities observed during the plastic flow of solids. It is a consequence of the dislocation mechanism which makes plastic flow fundamentally inhomogeneous, and is exacerbated by local adiabatic heating. Dislocation lines tend to be clustered on sets of neighboring glide planes because they are heterogeneously generated; especially through the Koehler multiple-cross-glide mechanism. Factors that influence their mobilities also play a role. Strain-hardening decreases the mobilities within shear bands thereby tending to spread (delocalize) them. Strain-softening has the inverse effect. This paper reviews the micro-mechanisms of these phenomena. It will be shown that heat production is also a consequence of the heterogeneous nature of the microscopic flow, and that dislocation dipoles play an important role. They are often not directly observable, but their presence may be inferred from changes in thermal conductivity. It is argued that after deformation at low temperatures dipoles are distributed a la Pareto so there are many more small than large ones. Instability at upper yield point, the shapes of shear-band fronts, and mechanism of heat generation are also considered. It is shown that strain-rate acceleration plays a more important role than strain-rate itself in adiabatic instability.

5974 (LBL–32827) **New developments in the "ab initio" determination of transition metal alloy phase diagrams.** Wolverton, C. (California Univ., Berkeley, CA (United States). Dept. of Physics); Asta, M.; Quannasser, S.; Dreysse, H.; de Fontaine, D. Lawrence Berkeley Lab., CA (United States). Apr 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-9204214–1: Thermodynamics of alloys 1992, Nancy (France), 28 Apr - 1 may 1992). Order Number DE93002540. Source: OSTI; NTIS; GPO Dep.

Certain classes of temperature-composition binary alloy phase diagrams can now be computed in an "ab-initio" approach. No adjustable or experimentally fitted parameter is used. The expectation value of the energy is expressed in terms of an expansion of cluster probabilities, where the prefactors, the Effective Cluster Interaction, are related to the alloy electronic structure. This framework is used to study the MoRe alloy for two situations: bulk and semi-infinite crystal bounded by a (001) surface. In both cases, good agreement with experimental data is found.

5975 (LBL–32831) **Phase stability of fcc- and hcp-based intermetallics: The Ti-Al and Cd-Mg systems.** Asta, M. (California Univ., Berkeley, CA (United States). Dept. of Materials Science and Mineral Engineering); McCormack, R.; van Schilfgaarde, M.; Ceder, G.; de Fontaine, D. Lawrence Berkeley Lab., CA (United States). Jun 1992. 7p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract AC03-76SF00098. Contract DAAL 03-91-G-0268. (CONF-9206202–5: NATO advanced study institute on statics and dynamics of alloy phase transformations, Rhodes (Greece), 21 Jun - 3 jul 1992). Order Number DE93002558. Source: OSTI; NTIS; GPO Dep.

In this paper we summarize results of first-principles phase stability studies of fcc- and hcp-based Ti-Al alloys and of the hcp-based Cd-Mg system. In particular, heats of formation for ordered alloy compounds are calculated with the linear muffin tin orbital method; effective cluster interactions are determined from the results of these calculations and are used to derive thermodynamic properties and composition-temperature phase diagrams.

5976 (NUREG/GR–0004) **Measurement and modeling of sensitization development in stainless steels as a function of thermomechanical processing.** Atteridge, D.G. (Oregon Graduate Inst. of Science and Technology, Beaverton, OR (United States). Dept. of Materials Science and Engineering); Simmons, J.W.; Li, M.; Bruemmer, S.M. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Oregon Graduate Inst. of Science and Technology, Beaverton, OR (United States). Dept. of Materials Science and Engineering. Nov 1992. 71p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

An analytical model has been developed for predicting thermo-mechanical effects on the development of grain boundary chromium depletion in austenitic stainless steel as a first step in predicting intergranular stress corrosion cracking susceptibility. Model development and validation is based on sensitization development analysis of over 30 Type 316 and 304 stainless steel heats. The data base included analysis of deformation effects on resultant sensitization development. Continuous cooling sensitization behavior is examined and modeled with and without strain. Gas tungsten arc girth pipe weldments are also characterized by experimental measurements of heat affected zone temperatures, strains and sensitization during/after each pass; pass by pass thermal histories are also predicted. The model is then used to assess pipe chemistry changes on chromium depletion changes.

5977 (ORNL/SUB–88-07685/03) **Evaluation of HAZ liquation cracking susceptibility and HAZ softening behavior in modified 800H.** Lundin, C.D. (Tennessee Univ., Knoxville, TN (United States). Dept. of Materials Science and Engineering); Qiao, C.Y.P. Oak Ridge National Lab., TN (United States); Tennessee Univ., Knoxville, TN (United States). Dept. of Materials Science and Engineering. 20 Nov 1992. 115p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93004064. Source: OSTI; NTIS; GPO Dep.

A modified 800H alloy, developed at Oak Ridge National Laboratory (ORNL), is one of the candidate materials designed for high temperature applications. Extensive mechanical and corrosion investigations have been completed and it has been proven that modified 800 has excellent high temperature mechanical and metallurgical behavior. Weldability studies of modified 800H are being carried out at the University of Tennessee, Knoxville. A series of modified 800H alloys and two similar commercial high temperature materials (310Ta and HR3C) were used to conduct this investigation. A preliminary weldability evaluation has been accomplished and the major part of the results (HAZ liquation cracking resistance and HAZ softening behavior in modified 800H) is addressed in this report. The basic conclusion of this investigation is that modified 800H material possesses good resistance to HAZ liquation cracking especially with a grain size control (thermo-mechanical treatment). The information from this study is important to the further modification of the material in order to extend its applications.

5978 (RFP–4610) **Application of molten salts in pyrochemical processing of reactive metals.** Mishra, B. (Colorado School of Mines, Golden, CO (United States). Kroll Inst. for Extractive Metallurgy); Olson, D.L.; Averill, W.A. EG and G Rocky Flats, Inc., Golden, CO (United States). Rocky Flats Plant. [1992]. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC34-90DP62349. (CONF-930219–1: The light metal symposium, Denver, CO (United States), 21-25 Feb 1993). Order Number DE92018618. Source: OSTI; NTIS; INIS; GPO Dep.

Various mixes of chloride and fluoride salts are used as the media for conducting pyrochemical processes in the production and purification of reactive metals. These processes generate a significant amount of contaminated waste that has to be treated for recycling or disposal. Molten calcium chloride based salt systems have been used in this work to electrolytically regenerate calcium metal from calcium oxide for the in situ reduction of reactive metal oxides. The recovery of calcium is characterized by the process efficiency to overcome back reactions in the electrowinning cell. A thermodynamic analysis, based on fundamental rate theory, has been performed to understand the process parameters controlling the metal deposition, rate, behavior of the ceramic anode-sheath and influence of the back-reactions. It has been observed that the deposition of calcium is dependent on the ionic diffusion through the sheath. It has also been evidenced that the recovered calcium is completely lost through the back-reactions in the absence of a sheath. A practical scenario has also been presented where the electrowon metal can be used in situ as a reductant to reduce another reactive metal oxide.

5979 (SAND–92-0400C) **Solderability of Kovar™.** Vianco, P.T.; Hosking, F.M. Sandia National Labs., Albuquerque, NM (United States). [1992]. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9211132–1: Symposium on low expansion alloys and composites, Chicago, IL (United States), 1-5 Nov 1992). Order Number DE93004067. Source: OSTI; NTIS; GPO Dep.

The wettability of bare Kovar by liquid 60Sn-40Pb solder was examined as a function of two surface preparation techniques. Adequate solderability was achieved with four organic acid fluxes when the Kovar surfaces were chemically etched in an acid solution; however, wetting was poor with the use of a rosin-based, mildly activated (RMA) flux. Changing to an electropolishing treatment with an acetic acid/perchloric acid electrolyte improved solder wetting, particularly with the RMA flux. Growth of the solder-substrate metallurgical reaction layer was examined after elevated-temperature annealing treatments. Intermetallic compounds grew both along the solder-substrate interface as well as in the solder phases, at rates much less than observed for the copper-solder system.

5980 (SAND–92-0889C) **Computational mechanics applied to the design and analysis of investment casting.** Gartling, D.K.; Givler, R.C.; Glass, M.W.; Hogan, R.E.; Rashid, M.M. Sandia National Labs., Albuquerque, NM (United States). [1992]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9210203–3: 40. annual Investment Casting Institute (ICI) technical meeting, Las Vegas, NV (United States), 4-7 Oct 1992). Order Number DE93002283. Source: OSTI; NTIS; GPO Dep.

Computational mechanics simulation capability via the finite element method is being integrated into the FASTCAST project to allow realistic analyses of investment casting problems. Commercial and in-house software is being coupled to new, solid model based mesh generation capabilities to provide improved access to fluid, thermal and structural simulations. These simulations are being used for the validation of complex gating designs and the study of fundamental problems in casting.

5981 (SAND–92-0921C) **Dissipation in adiabatic shear bands.** Grady, D.E. Sandia National Labs., Albuquerque, NM (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9209240–2: Society of Engineering Science (SES) technical meeting, San Diego, CA (United States), 14-16 Sep 1992). Order Number DE93002280. Source: OSTI; NTIS; GPO Dep.

In the present study of adiabatic shear banding in metals, the region of interest is modelled as a two-material two-temperature body. Specific material laws governing thermoviscous plasticity and heat transfer ate ascribed to the shear-band zone. Momentum and

energy balance lead to a system of one-dimensional ordinary differential equations describing the dynamics of the shear localization process. The propagating shear band is viewed as having two distinct regions. The first is the shear-band tip process zone within which adiabatic heating, thermal softening and all shear dissipation are considered to occur. The second is the late-time quasi-steady zone in which the shear stress and dissipation rate are close to zero. The analysis provides the width and displacement of the shear band process zone. In addition, criteria for assessing material shear-banding resistance are investigated in terms of a shear-band dissipation rate, or a. shear-band toughness. Shear-band dissipation and shear-band toughness for a number of metals are calculated and compared.

5982 (SAND–92-2041C) **Gating geometry studies of thin-walled 17-4PH investment castings.** Maguire, M.C.; Zanner, F.J. Sandia National Labs., Albuquerque, NM (United States). [1992]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9210203–1: 40. annual Investment Casting Institute (ICI) technical meeting, Las Vegas, NV (United States), 4-7 Oct 1992). Order Number DE93002165. Source: OSTI; NTIS; GPO Dep.

The ability to design gating systems that reliably feed and support investment castings is often the result of "cut-and-try" methodology. Factors such as hot tearing, porosity, cold shuts, misruns, and shrink are defects often corrected by several empirical gating design iterations. Sandia National Laboratories is developing rules that aid in removing the uncertainty involved in the design of gating systems for investment castings. In this work, gating geometries used for filling of thin walled investment cast 17-4PH stainless steel flat plates were investigated. A full factorial experiment evaluating the influence of metal pour temperature, mold preheat temperature, and mold channel thickness were conducted for orientations that filled a horizontal flat plate from the edge. A single wedge gate geometry was used for the edge-gated configuration. Thermocouples placed along the top of the mold recorded metal front temperatures, and a real-time x-ray imaging system tracked the fluid flow behavior during filling of the casting. Data from these experiments were used to determine the terminal fill volumes and terminal fill times for each gate design.

5983 (SAND–92-2298C) **Chemistry of copper CVD precursors on a Pt(111) surface.** Parmeter, J.E.; Ormstead, T.R. Sandia National Labs., Albuquerque, NM (United States). [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9210220–1: Advanced metallization for ULSI applications in 1992, Tempe, AZ (United States), 20-22 Oct 1992). Order Number DE93003250. Source: OSTI; NTIS; GPO Dep.

We have investigated the chemistry of $Cu(hfac)_2$, (hfac)Cu(VTMS), (hfac)Cu(2-butyne), and hfach on a Pt(111) surface. In contrast to what is observed on copper surfaces. Cu(hfac)2 and hfach lead to the formation of distinctly different adsorbed hfac species on Pt(111). This shows the importance of the copper atoms themselves in determining the surface chemistry of copper β-diketonate CVD precursors. The hfac species on Pt(111) are considerably less stable than hfac on copper, suggesting that unimolecular decomposition may lead to impurity incorporation in the interfacial region when copper is deposited onto a more reactive substrate. In situ CVD studies with Cu(I) β-diketonates show that the bimolecular disproportionation reaction leading to copper CVD is favored over unimolecular precursor decomposition at pressures above approximately 10^{-5} torr.

5984 (SAND–92-2408C) **Role of atomic size and valence in bonding and diffusion at metal surfaces.** Feibelman, P.J. Sandia National Labs., Albuquerque, NM (United States). [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-921101–8: Material Research Society fall meeting, Boston, MA (United States), 30 Nov - 5 dec 1992). Order Number DE93003994. Source: OSTI; NTIS; GPO Dep.

First-principles calculations and corresponding experimental results underline the importance of basic chemical concepts in understanding bonding and diffusion of atoms at and on metal surfaces. Examples discussed include the outward relaxation of clean KBe(0001), the separation energies of metal-adatom dimers, concerted substitutional self-diffusion on fcc(001) and (110) surfaces, and adsorption and diffusion barrier sites for adatoms near steps.

5985 (TKK-S/SM–1989/21, pp. 107-114) **Double-motor MHD-drive for casting robot.** Pottai, E. (Tallinn Technical Univ. (Estonia). The Scientific Lab. of Electric Drives). Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Electromechanics. 1989. (CONF-8901144–: Symposium on electrical power engineering at the Helsinki University of Technology, Espoo (Finland), 27 Jan 1989). In *Symposium on electrical power engineering*. 130p. Order Number DE93711132. Source: OSTI; NTIS.

This paper is dedicated to the principles of the construction and control of the double-motor magnetohydrodynamic drive (MHD) that is being worked out at Tallinn Technical University. The drive is meant for dosing out nonferrous liquied metals into various casting forms. The drive is mostly meant for casting alloys the temperature of which does not exceed 750 deg C degrees Centigrade (e.g. lead, magnesium, aluminium and the analoqous ones). The drive may be used in the body of a casting robot. The results of the experiment are presented at the end of the paper.

5986 (TVA-Bull–Z-298) **Corrosion of mild steel exposed to urea-ammonium sulfate suspensions.** Nichols, D.E.; Nguyen, D.T.; Boles, J.L. National Fertilizer and Environmental Research Center, Muscle Shoals, AL (United States). [1991]. 23p. Sponsored by Tennessee Valley Authority, Knoxville, TN (United States). (CONF-910812–16: 202. national meeting of the American Chemical Society (ACS), New York, NY (United States), 25-30 Aug 1991). Order Number DE93002581. Source: OSTI; NTIS.

Sulfur is generally referred to as a secondary plant nutrient but it actually ranks in importance with nitrogen and phosphorus in protein synthesis. Since the mid 1970's, the National Fertilizer and Environmental Research Center (NFERC) has been involved in development of technologies to produce low-cost, sulfur-containing fertilizers. In 1984, NFERC developed and later patented a new family of nitrogen-sulfur fluid fertilizers produced from by-product ammonium sulfate or sulfuric acid. These products contain small ammonium sulfate crystals suspended in saturated solution by gelling clay. The suspensions can be produced in a wide range of grades and ratios and have good long-term storage properties. Typical grades are 13-0-0-15S, 15-0-0-17S, 20-0-0-15S, 25-0-0-10S, and 28-0-0-5S. Because the suspensions can be made with by-product ammonium sulfate or sulfuric acid, they have a substantial economic advantage over ammonium thiosulfate- or elemental sulfur-based fluids. However, due to the corrosive nature of the ammonium sulfate in these suspensions, deterioration of storage and transport containers is a major concern. To evaluate the corrosive behavior of the suspensions and determine suitable corrosion inhibitors, the NFERC corrosion laboratory in Muscle Shoals, Alabama, conducted a series of corrosion tests on carbon steel and stainless steels exposed to these suspensions at ambient and 130°F temperatures.

5987 (TVA-Bull–Z-299) **Corrosion of mild steel exposed to inhibited urea–ammonium nitrate solution at ambient temperature under static conditions.** Nguyen, D.T. (National Fertilizer and Environmental Research Center, Muscle Shoals, AL (United States)); Nichols, D.E.; Boles, J.L.; Lohry, E.J. National Fertilizer and Environmental Research Center, Muscle Shoals, AL (United States). [1991]. 18p. Sponsored by Tennessee Valley Authority, Knoxville, TN (United States). (CONF-910812–19: 202. national meeting of the American Chemical Society (ACS), New York, NY (United States), 25-30 Aug 1991). Order Number DE93002455. Source: OSTI; NTIS.

A series of corrosion tests was performed with mild steel exposed to 32-0-0 UAN solution at ambient temperature, under static conditions, and at pHs of 6.8 to 7.2 to evaluate the effectiveness of several new corrosion inhibitors. Results of the tests revealed that the pH of 32-0-0 UAN in the neutral range does not significantly affect the corrosion rate of mild steel after prolonged exposure. The corrosion rate of mild steel was 60 to 70 mpy. Results of tests with inhibitors showed that 100 ppm of Surtech 143 from Surface Chemists of Florida, Inc., provided excellent corrosion resistance (approximately 1 mpy after long-term exposure). With a 5-minute

surface treatment, Rust Resistor from Nutra-Flo Co., provided excellent corrosion resistance (corrosion rates less than 1 mpy). Corblok at 100 ppM provided excellent corrosion resistance up to 14 days (corrosion rate of approximately 2 mpy); the corrosion rate increased slightly when exposed for 28 days. Surtech 145 and Surtech 433 provided only limited protection.

5988 (TVA-Bull–Z-300) **The effect of conditioning agents on the corrosive properties of molten urea.** Nichols, D.E.; Nguyen, D.T.; Norton, M.M.; Parker, B.R.; Daniels, L.E. National Fertilizer and Environmental Research Center, Muscle Shoals, AL (United States). [1991]. 16p. Sponsored by Tennessee Valley Authority, Knoxville, TN (United States). (CONF-910812–18: 202. national meeting of the American Chemical Society (ACS), New York, NY (United States), 25-30 Aug 1991). Order Number DE93002453. Source: OSTI; NTIS.

From the process case histories of the failure of several heat exchanger tube bundles, it was revealed that molten urea containing lignosulfonate as a granulation conditioning-hardening agent (Urea LS™) is corrosive to Types 304 and 316 stainless steel. The results of field and laboratory immersion corrosion tests indicated that the corrosivity of molten urea is strongly dependent on the process temperature rather than the conditioner composition. At temperatures below 295F, molten Urea LS™ is not aggressive to these stainless steels. However, at temperatures above 300F, the corrosion of these stainless steels is extremely severe. The corrosion rate of Types 304, 304L, 316, and 316L is as high as hundreds of mils per year. The corrosion mechanism tends to be more general than localized. The results of the laboratory corrosion test also revealed that among alloying elements, copper is detrimental to corrosion resistance of stainless steel exposed to molten Urea LS™, chromium is the most beneficial, and nickel has only a minor effect. Thus, copper-free and chromium stainless steels have superior corrosion resistance to the molten Urea LS™ at a wide range of temperatures up to 345F.

5989 (UCRL–53943-91, pp. 11-13) **Studies of the omega phase transformation in the titanium-molybdenum alloy system.** Tanner, L.E. (Univ. of Antwerp, (Belgium)); Schryvers, D.; Shapiro, S.M. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

High-resolution electron microscopy and neutron-scattering studies have documented that in the course of transformation of the Ti-Mo β phase, the high-pressure-stable ω phase can be nucleated by an atomic displacive mechanism. This is accomplished by a local heterogeneous process involving the coupling of a β-phase phonon anomaly with the strain fields of lattice defects. The studies have also shown that the metastable ω phase can compete effectively with stable phases during certain thermal aging treatments.

5990 (UCRL–53943-91, pp. 29-31) **Ordering in the Ti-Pd alloy system.** Jankowski, A.F.; Turchi, P.E.A. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

Physical vapor deposition provides a direct means to prepare specimens for the study of order-disorder transformations in complex crystal systems, such as titanium-palladium. Rapid quenching takes place from the vapor phase to the solid state, leading to the formation of high-temperature and metastable structures. The author observed subsequent ordering by using hot stage electron microscopy in situ. Amorphous (Pd>33 at.%) and A15 (Pd<33 at.%) phases are found in the as-deposited structures for the first time.

5991 (UCRL–53943-91, pp. 32-35) **Deformation behavior of pre-shocked copper as a function of strain rate and temperature.** Lassila, D.H. (Lawrence Livermore National Lab., CA (United States)); Gourdin, W.H. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

From quasistatic compression data for 30-μm grain-size samples of oxygen-free electronic (OFE) grade copper shocked to 10 GPa for 1 μs, the authors derive a value for the thermal component of the mechanical threshold stress (MTS). Model calculations of the flow stress based on this value provide an excellent description of the uniaxial deformation of pre-shocked specimens tested in compression at low and high strain rates. The authors have obtained excellent agreement with data obtained from electromagnetically launched expanding-ring experiments in which excursions of both temperature and strain rate are large.

5992 (UCRL–53943-91, pp. 36-38) **Fatigue behavior of U-6Nb alloys.** Freeman, D.C. (Lawrence Livermore National Lab. CA (United States)); Strum, M.J.; Elmer, J.W.; Nguyen, N.Q. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

The authors evaluated the fatigue behavior of uranium alloy U-6Nb aged at 200 C for 2 h using fracture mechanics methods. They found that crack closure associated with crack branching results in a fatigue threshold of 3.2 $MPa\sqrt{m}$ at a load ratio of 0.1. Tests at high load ratio eliminate crack closure and reduce the fatigue threshold to 0.9 $MPa\sqrt{m}$ in air and to 1.5 $MPa\sqrt{m}$ in dry nitrogen. Fatigue-crack growth rates drop by a factor of 5 in dry nitrogen because of corrosion fatigue in air at 50% relative humidity.

5993 (UCRL–53943-91, pp. 39-41) **A model for the formation of bands of ultrafine particles in rapidly solidified aluminum-beryllium alloys.** Aziz, M.J. (Harvard Univ., Cambridge, MA (United States)); Elmer, J.W.; Tanner, L.E. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

Rapid-solidification processing of aluminum-beryllium alloys produces a dispersion of ultrafine beryllium particles in an aluminum alloy matrix. This dispersion is highly desirable because it strengthens the alloy while providing macroscopically homogeneous mechanical properties. In Al-5 at.% Be, the rapidly solidified microstructure consists of 10-nm-diameter, beryllium-rich particles that are periodically spaced in arrays parallel to the solidification front. To model and explain the formation of this unique banded microstructure, the authors used a numerical method with liquid-phase nucleation.

5994 (UM-P–92/23) **Carbon diffusion in uncoated and titanium nitride coated iron substrates during microwave plasma assisted chemical vapor deposition of diamond.** Weiser, P.S. (Melbourne Univ., Parkville (Australia). School of Physics); Prawer, S.; Hoffman, A.; Manory, R.R.; Paterson, P.J.K.; Stuart, Sue-Anne. Melbourne Univ., Parkville, VIC (Australia). School of Physics. [1992]. [14] Order Number DE93608934. Source: OSTI; NTIS (US Sales Only); INIS.

Auger Electron Spectroscopy has been employed to investigate the effectiveness of thin films of TiN as barriers to carbon diffusion during Chemical Vapor Deposition (CVD) of diamond onto Fe substrates. Auger Depth Profiling was used to monitor the C concentration in the TiN layer, through the interface and into the substrate both before and after CVD diamond deposition. The results show that a layer of TiN only 250 Angstroems thick is sufficient to inhibit soot formation on the Fe surface and C diffusion into the Fe bulk. 14 refs., 4 figs.

5995 (UM-P–92/34) **Hierarchical textures in ferroelectric crystals.** Peng, Julin; Bursill, L.A. Melbourne Univ., Parkville, VIC (Australia). School of Physics. [1992]. [9] Sponsored by Australian Research Council, Canberra, ACT (Australia). Order Number DE93608938. Source: OSTI; NTIS (US Sales Only); INIS.

Some results from a new study of the relaxor-like material known as PST, lead scandium tantalate $Pb(Sc_{0.5}Ta_{0.5}O_3)$ are presented. The emphasis is on some novel electron optical results and techniques. It will be shown that the High Resolution Transmission Electron Microscopy techniques offer a new level of understanding of the nano structure of PST. 4 refs., 5 figs.

5996 (UM-P–92/54) **Microdomain fluctuations in lead scandium tantalate (PST) observed by high resolution transmission electron microscopy.** Bursill, L.A.; Peng, Julin. Melbourne Univ., Parkville, VIC (Australia). School of Physics.

[1992]. [7] Sponsored by Australian Research Council, Canberra, ACT (Australia). Order Number DE93608939. Source: OSTI; NTIS (US Sales Only); INIS.

The value of the high-resolution transmission electron microscopy (HRTEM) and dark-field imaging techniques for obtaining nanocrystalline structural information is demonstrated for lead scandium tantalite (PST). Chemical domain textures, polar domain fluctuations and HRTEM images of disordered and ordered PTS are discussed. 5 refs., 5 figs.

5997 (Y/DZ–943) **Vacuum deposition of copper on Type 304L stainless steel.** Vasofsky, R.W.; Corbett, W.D. Jr. Oak Ridge Y-12 Plant, TN (United States). 3 Sep 1992. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OS21400. Order Number DE93002704. Source: OSTI; NTIS; INIS; GPO Dep.

The standard procedure for electroplating a thin layer of copper on type 304L stainless steel requires several aqueous pretreatment steps. Several of these steps are associated with the generation of Resource Conservation and Recovery Act (RCRA) hazardous wastes. An investigation was conducted to determine if a more environmentally acceptable procedure can be implemented to replace the current approach. The study consisted of vacuum depositing copper onto 1-in.-square 304L coupons under different vacuum deposition conditions and, subsequently, examining the microstructure and adhesive properties of the coating produced. The results indicated that a noncolumnar, fine-grain copper coating with high adhesion can be produced using this environmentally more acceptable approach.

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Refer also to citation(s) 5219, 5225, 5824, 5888, 5945, 5968, 5971, 6041, 6081, 6089, 6114, 6259, 6262, 7081, 7125, 7126, 7127, 7128, 7129, 7254, 7283, 7284, 7285, 7287, 7318, 7319, 7321, 7322, 7324, 7325, 7331, 7341, 7354, 7365, 7367, 7369, 7370

5998 (ANL/CP–77481) **Effective activation energy in the Bi-Sr-Ca-Cu-O systems.** Sengupta, S. (Argonne National Lab., IL (United States)); Shi, D.; Wang, Z.; Smith, M.; McGinn, P.J. Argonne National Lab., IL (United States). Aug 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38 ;FG02-90ER45427. (CONF-920802–36: Applied superconductivity conference, Chicago, IL (United States), 23-28 Aug 1992). Order Number DE93002996. Source: OSTI; NTIS; GPO Dep.

Magnetic relaxation in the Bi-Sr-Ca-Cu-O systems has been investigated in a wide temperature regime. Previously reported studies of the effective activation energy, U, have been controversial in terms of temperature and field dependence of the critical current density, j_c. We have considered the temperature dependence of j_c and constructed the U-j (or M) curves for the Bi-Sr-Ca-Cu-O system. We found that at a constant driving force and temperature, U is considerably higher for 2245 samples than for 2223 samples. This enhancement can be attributed to the flux pinning from finely dispersed calcium- and copper- rich precipitates.

5999 (ANL/CP–77533) **Critical current density, irreversibility line, and flux creep activation energy in silver-sheathed $Bi_2Sr_2Ca_2Cu_3O_x$ superconducting tapes.** Shi, D. (Argonne National Lab., IL (United States)); Wang, Z.; Sengupta, S.; Smith, M.; Goodrich, L.F.; Dou, S.X.; Liu, H.K.; Guo, Y.C. Argonne National Lab., IL (United States). Aug 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38 ;FG02-90ER45427. (CONF-920802–30: Applied superconductivity conference, Chicago, IL (United States), 23-28 Aug 1992). Order Number DE93002998. Source: OSTI; NTIS; INIS; GPO Dep.

Transport data, magnetic hysteresis and flux creep activation energy experimental results are presented for silver-sheathed high-T_c $Bi_2Sr_2Ca_2Cu_3O_x$ superconducting tapes. The 110 K superconducting phase was formed by lead doping in a Bi-Sr-Ca-Cu-0 system. The transport critical current density was measured at 4.0 K to be 0.7×10^5 A/cm^2 (the corresponding critical current is 74 A) at zero field and 1.6×10^4 A/cm^2 at 12 T for H||ab. Excellent grain alignment in the a-b plane was achieved by a short-melting method, which considerably improved the critical current density and irreversibility line. Flux creep activation energy as a function of current is obtained based on the magnetic relaxation measurements.

6000 (ANL/CP–77534) **Studies of microstructure/critical current density relationships for grain boundaries in $YBa_2Cu_3O_{7-\delta}$ bicrystals.** Babcock, S.E. (Wisconsin Univ., Madison, WI (United States)); Cai, Xue-Yu; Larbalestier, D.C.; Shin, D.H.; Zhang, Na; Gao, Yufei; Merkle, K.L.; Kaiser, D.L.; Zhang, Hong. Argonne National Lab., IL (United States). [1992]. 5p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract W-31109-ENG-38. Contract DMR-88-09854. (CONF-920670–6: 6. international conference on intergranular and interphase boundaries in materials, Thessaloniki (Greece), 22-26 Jun 1992). Order Number DE93003000. Source: OSTI; NTIS; GPO Dep.

Results of coupled electromagnetic and microstructural studies of bicrystalline $YBa_2Cu_3O_{7-\delta}$ specimens are described from a microstructural perspective. High-spatial-resolution transmission electron microscopy techniques (imaging and energy dispersive x-ray microanalysis) are used to probe the structure and composition of the grain boundaries. All of the boundaries studied possess microstructural features that are consistent with their specific electromagnetic character.

6001 (ANL/MSD/CP–77605) **Microstructural characterization of Ag-sheathed Tl-Ba-Ca-Cu-O and Bi-Sr-Ca-Cu-O superconducting tapes by analytical electron microscopy.** Hu, J.G.; Miller, D.J.; Goretta, K.C.; Poeppel, R.B. Argonne National Lab., IL (United States). Sep 1992. 5p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract W-31109-ENG-38. Contract DMR-8809854. (CONF-920802–29: Applied superconductivity conference, Chicago, IL (United States), 23-28 Aug 1992). Order Number DE93002980. Source: OSTI; NTIS; GPO Dep.

The microstructures of Tl(1223) and Pb-doped Bi(2223) silver tapes produced by the powder-in-tube (PM) method have been examined by scanning electron microscopy (SEM), transmission electron microscopy (TEM) and energy dispersive spectrometry (EDS). The Tl tapes annealed below the melting point exhibited fine grains and a high density of pores while tapes subjected to partial melting prior to solid state annealing were fully dense with large grains. However, these tapes also showed an increase in the size and density of impurity particles, particularly CaO and a Ba-Cu rich phase. Silver powders added to the precursors tended to promote the growth of Tl(1223) at lower temperatures but also interfered with the development of texture by providing nucleation sites of random orientations. In contrast, the Bi(2223) tape exhibited a high degree of texture and alignment. The incorporation of silver within the superconducting phase was found to be negligible for both the Tl(1223) and Bi(2223) tapes.

6002 (ANL/MSD/CP–77606) **Positron annihilation studies of the electronic structure and fermiology of the high-T_c superconductors.** Smedskjaer, L.C. (Argonne National Lab., IL (United States)); Bansil, A. Argonne National Lab., IL (United States). Sep 1992. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9209267–1: 10. Sagamore conference on charge, spin and momentum densities, Konstanz (Germany), 1-7 Sep 1992). Order Number DE93002982. Source: OSTI; NTIS; GPO Dep.

We discuss the application of the positron annihilation angular correlation (ACAR) spectroscopy for investigating the electronic structure and Fermiology of the high-T_c superconductors, with focus on the $YBa_2Cu_3O_7$ system where most of the experimental and theoretical work has to date been concentrated. Comparisons between measured 2D-ACAR positron spectra and band theory predictions show a remarkable agreement (for the normal state), indicating that the electronic structure and Fermi surface of this material is described reasonably by the conventional picture.

6003 (CONF-8909210–, pp. 397-419) **Some basic phenomena and their importance in relation to techniques for sputter- and vapor-deposition of high temperature superconducting thin films.** Auciello, O. (Microelectronics Center of North Carolina,

Research Triangle Park (United States)). Oak Ridge National Lab., TN (United States). Apr 1990. DOE Contract W-31109-ENG-38 ;FG05-88ER45359. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

The processes involved in plasma and ion beam sputter-, electron evaporation-, and laser ablation-deposition of high $T_c$superconducting thin films are critically reviewed. Recent advances in the development of these techniques are discussed in relation to basic physical phenomena, specific to each technique, which must be understood before high quality films can be grown. Low temperature processing of films is a common goal for each technique, and efforts in this area using activated oxygen sources are discussed in view of integrating the high $T_c$superconducting thin films with current microelectronic technologies.

6004 (CONF-9203138–2) **A round-robin for particle electrophoresis standardization.** Janney, M.A. Oak Ridge National Lab., TN (United States). [1992]. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Engineering Foundation conference on dispersion and aggregation; Palm Coast, FL (United States); 15-20 Mar 1992. Order Number DE93003018. Source: OSTI; NTIS; GPO Dep.

The ability to measure the electrophoretic mobility (EM) of solid particles in a repeatable manner is critically important in the specification of ceramic powders for advanced heat engines. A joint research project conducted by ORNL, Rutgers University, University of Florida and University of Wisconsin to standardize EM measurements has been completed. Its purpose was to define the procedures by which repeatable, inter-laboratory, capillary microelectrophoretic mobility and pH measurements could be made on ceramic powders in aqueous suspension. Both "model" colloids and silicon nitride ceramic powder were evaluated. "Model" systems were considered as potential standards for the initial calibration and check-out of mobility measurements at the four laboratories. These included surface-treated and unmodified polymer lattices, phosphated goethite, and red blood cells. The results indicate that phosphated goethite is the best standard material. The suspensions were stable for many months; they were easy to measure; and, their zero-mobility pH's were predictable based on the phosphate addition level. Interlaboratory agreement of mobility vs pH was excellent. Following the work on goethite, a study of the mobility of silicon nitride was conducted. This work showed that repeatable interlaboratory measurements could be made on silicon nitride, a ceramic system that exhibits significant aging in aqueous suspension. Lessons learned from the goethite experience were invaluable in conducting the measurements on silicon nitride.

6005 (CONF-9208129–7) **Neutron diffraction study of the pseudo-macro residual stresses in $ZrO_2(CeO_2)/Al_2O_3$ ceramic composites.** Wang, Xum-Li; Hubbard, C.R.; Alexander, K.B.; Becher, P.F.; Fernandez-Baca, J.A.; Spooner, S. Oak Ridge National Lab., TN (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Annual Denver x-ray conference; Denver, CO (United States); 3-7 Aug 1992. Order Number DE93003105. Source: OSTI; NTIS; GPO Dep.

Neutron powder diffraction techniques have been used to characterize the pseudo-macro (PM) residual stresses in $ZrO_2(CeO_2)/Al_2O_3$ ceramic composites as a function of $ZrO_2(CeO_2)$ volume fraction and fabrication procedures. The diffraction data were analyzed using the Rietveld structure refinement technique. From the refinement, we found that the CeO_2 stabilized tetragonal ZrO_2 particles were in tension and the Al_2O_3 matrix was in compression. Different sintering time had little impact on the PM stresses. On the other hand, the magnitude of the PM stresses in both ZrO_2 and Al_2O_3 decreased linearly with the increase of their volume fractions.

6006 (CONF-921121–1) **The synthesis of metal hydrous oxide particles by multiphase electrodispersion.** Harris, M.T.; Scott, T.C.; Byers, C.H. Oak Ridge National Lab., TN (United States). [1992]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 3. joint conference of European East-West conference on materials and processes and European Materials Research Society fall meeting; Strasbourg (France); 3-6 Nov 1992. Order Number DE93003017. Source: OSTI; NTIS; GPO Dep.

A multiphase electrodispersion precipitation reactor caned the Electric Dispersion Reactor (EDR) was developed to synthesize ultrafine particles for the production of precursor powders of advanced ceramic materials. A pulsed electric field is employed to create dispersions of micron- and submicron-scale conducting (aqueous-based) drops in nonconducting (organic) liquids. Species initially dissolved in the organic phase diffuse into the aqueous droplets containing the other reagents. Reaction ensues leading immediately to precipitation and gelation in the aqueous droplets. The EDR has produced 0.1 to 5 micron particles of silica, alumina, zirconia, yttria, and composite hydrous oxide particles from metal alkoxide and metal salt precursors. Also considered is the application of the EDR to the control and modification of morphological characteristics of these particles with illustrative examples.

6007 (CONF-9211144–2) **Magnetization and flux pinning in high-$T_c$cuprates: Irradiated and oxygen deficient materials.** Thompson, J.R. (Oak Ridge National Lab., TN (United States)); Sun, Yang Ren; Ossandon, J.G.; Christen, D.K.; Kerchner, H.R.; Sales, B.C.; Chakoumakos, B.C.; Civale, L.; Marwick, A.D.; Holtzberg, F. Oak Ridge National Lab., TN (United States). Nov 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 5. United States/Japan workshop on high T_c superconductors; Tsukuba (Japan); 9-10 Nov 1992. Order Number DE93004169. Source: OSTI; NTIS; INIS; GPO Dep.

This work surveys recent studies of the intragrain current density J and vortex pinning in high Tc superconductors. Materials include $Y_1Ba_2Cu_3O_{7-\delta}$ and $Bi_2Sr_2Ca_1Cu_2O_8$ single crystals and aligned polycrystals. To probe the flux pinning, we modified the strength, number, and morphology of defects. Varying the oxygen content ($7-\delta$) in $YBa_2Cu_3O_{7-\delta}$ or irradiating the materials with ions, having either light or heavy masses, gives systematic changes in the character of the all-important defects.

6008 (DOE/ER/45223–1) **Positron studies of defected metals, metallic surfaces: Final report, July 1, 1985–December 1, 1991.** Bansil, A. Northeastern Univ., Boston, MA (United States). Dept. of Physics. [1991]. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-85ER45223. Order Number DE93006089. Source: OSTI; NTIS; INIS; GPO Dep.

Specific problems proposed under this project included the treatment of electronic structure and momentum density in various disordered and defected systems. Since 1987, when the new high-temperature superconductors were discovered, the project focused extensively on questions concerning the electronic structure and Fermiology of high-$T_c$superconductors, in particular, (i) momentum density and positron experiments, (ii) angle-resolved photoemission intensities, (iii) effects of disorder and substitutions in the high-T_c's.

6009 (ETDE/JP-mf–93753763, pp. 367-373) **Structure and electronic properties of oxide superconductor.** Kitazawa, K. (The University of Tokyo, Tokyo (Japan). Faculty of Engineering). Cryogenic Association of Japan, Tokyo (Japan). [1991]. 606p. (In Japanese). In *Proceedings of the 1st-4th cryogenic engineering summer seminar (1988-1991).* Order Number DE93753763. Source: OSTI; NTIS (US Sales Only).

The oxide superconductor was explained in structure and electronic properties. The high temperature oxide superconductor contains CuO_2layer as a structural unit. Constituted of copper and oxygen, that layer is latticed to a two-dimensional tetragon. The number of sheets of CO_2 layer as a unit is 1 and 2.5 at 40K class and 90K class, respectively. There are also composite laminar structures containing Bi_2O_2 or Tl_2O_2 layer apart from the CuO_2layer Though it is sure that the CuO_2face serves as a passage of electric conduction, the conducting zone even if half filled forms an insulator having an energy gap. Such a singularity is attributable to the electrostatic interelectron repulsion energy which surpasses the breadth of zone. In the oxide where the electrons are localized on such a one-by-one basis as is in the above, the electronic spin is easily arranged to resist the strong magnetism. The introduction of electronic cavity occasionally destroys the long

distance order of spin arrangement to resist the strong magnetism and has a fluidization occur. There must be a delicate balance among the electronic correlation, mutual action to resist the strong magnetism, electronic trend of non-localization, etc. Study was made also of specific resistance, magnetic susceptibility and optical reflectance. 4 refs., 5 figs.

6010 (ETDE/JP-mf–93753763, pp. 374-385) **High critical temperature superconduction. Part 2.** Tokano, K. (National Research Institute for Metals, Tsukuba (Japan)). Cryogenic Association of Japan, Tokyo (Japan). [1991]. 606p. (In Japanese). In *Proceedings of the 1st-4th cryogenic engineering summer seminar (1988-1991).* Order Number DE93753763. Source: OSTI; NTIS (US Sales Only).

The oxide superconductor was explained in practical performance and material development to use the wire rod. The oxide superconductor is hard and brittle. In the metal covering material preparation of solid phase method to use the wire rod, the oxide powder is stuffed into a metallic tube, processed with swaging, wire drawing, rolling, etc., prepared to a line or tape state and finally treated by heat. In the organic bonding agent preparation, the oxide powder is mixed with bonding agent, dispersant, plasticizer, etc., prepared to a thin plate or thread state and finally sintered. There are two kinds of liquid phase method, i.e., method of directly dissolving/condensing the oxide, and that of dissolving all metals except oxygen and later oxidizing them. The molding is made with rolling, spraying, etc. A proper orientation/alignment can be given also by the one-directional condensation. The gaseous phase method is of physical vapor deposition or chemical vapor deposition. Though required to be higher than $10^4 A/cm^2$ in the strongest generated magnetic field, the critical current density has not attained to the practically usable level yet because of prevention of the current from flowing in the crystalline grain field, limitation on the total characteristics due to the heterogeneity of critical characteristics and weakness in pinning force of the magnetic flux lines. 20 refs., 13 figs., 2 tabs.

6011 (ETDE/JP-mf–93753763, pp. 404-421) **Side view of new application of high critical temperature superconductor.** Murakami, M. (Superconductivity Research Laboratory, Tokyo (Japan)). Cryogenic Association of Japan, Tokyo (Japan). [1991]. 606p. (In Japanese). In *Proceedings of the 1st-4th cryogenic engineering summer seminar (1988-1991).* Order Number DE93753763. Source: OSTI; NTIS (US Sales Only).

The present report generally explained the points of problem raised by putting the high temperature oxide superconductor to practical use. As a result of investigating the essential factors of critical current density (J_c) which are the carrier concentration, coherence length, ideal J_c, magnetic flux pinning, thermal activity and thermal fluctuation, the required condition for the high temperature oxide superconductor is the removal of granular field which may become an obstacle to the superconductive current and introduction of an effective pinning point to the magnetic flux. If made to grow slowly on a temperature slope, the crystals are oriented in the direction of priority and J_c is simultaneously improved by removing the granular field which may become obstacle to the superconductive current. If the normal conductive and other phases, other than the superconductive plase, can be trapped finely and uniformly into the superconductive phase, it gives a pinning effect as the dislocation of magnetic flux is energywise controlled. As an application of high J_c bulk superconductive materials, explanation was made of magnetic levitation, application to the bearing and flywheel, and carrier system. 6 refs., 19 figs.

6012 (ETDE/JP-mf–93753763, pp. 532-548) **Measurement of superconductive characteristics.: Trend toward the standardization and method of measurement.** Noto, K. (Iwate University, Iwate (Japan). Faculty of Engineering). Cryogenic Association of Japan, Tokyo (Japan). [1991]. 606p. (In Japanese). In *Proceedings of the 1st-4th cryogenic engineering summer seminar (1988-1991).* Order Number DE93753763. Source: OSTI; NTIS (US Sales Only).

Taking the oxide high temperature superconductive materials as an example, the present report explained the measurement method of various superconductive characteristics and its points of problem. The critical temperature is measured from the electric resistance or change by temperature in magnetization. The dependency of electric resistance upon the magnetic field being measured by a microcurrent, the intensity (H_{C2}) of upper critical magnetic field must be equal to that of the magnetic field at the time when the electric resistance starts to appear. However, the curve of electric resistance appearance (or transition) becomes very broad during the change in intensity of magnetic field. Therefore, the above curve is measured at the time when the temperature changes under a constant intensity of magnetic field. Then, the H_{C2} is derived from the thus measured transitional curve. As for the measurement of critical current density, there is electrical resistance method by having the current flow and measuring the voltage, and magnetization method by impressing the magnetic field and measuring the magnetization. In the adiabatic method for the specific heat test evaluation, the thermal capacity is obtained from the heightening in temperature at the time when a thermal quantity is given to the test piece in an adiabatic space. In the thermal mitigation method, the thermal capacity is obtained from the thermal balance at the time when the test piece which is given a thermal quantity comes in a thermal contact with a hot both at constant temperature by a thermal leakage of conduction. There are also AC method which obtains the thermal capacity from the AC component of temperature of the periodically heated test piece and scanning type differential heat method.The thermal conductivity is measured by the steady thermal flow rate method. 40 refs., 32 figs., 1tab.

6013 (FTINT–31-89) **Thermal conductivity of high-temperature superconducting materials (review of experimental results).** Kirichenko, Yu.A.; Rusanov, K.V.; Tyurina, E.G. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. Nizkikh Temperatur. 1989. [47] (In Russian). Order Number DE93609032. Source: OSTI; NTIS (US Sales Only); INIS.

Experimental data derived by Soviet and foreign researchers on the thermal conductivity and thermal diffusivity of three classes of HTS materials are analysed. The specific features of the dependence of the thermal conductivity on the sample temperature, chemical composition, porosity and magnetic field strength are examined. A brief survey of current hypothetical reasoning for the above features is presented. 68 refs.; 15 figs.; 3 tabs.

6014 (IKM–003) **Cyclic and static fatigue of silicon nitride materials at room temperature.** Weddigen, A. Karlsruhe Univ. (T.H.) (Germany). Inst. fuer Keramik im Maschinenbau; Karlsruhe Univ. (T.H.) (Germany). Fakultaet fuer Maschinenbau. Feb 1992. 149p. (In German). Order Number DE93742844. Source: OSTI; NTIS (US Sales Only); INIS.

In this work, investigations are described on the cyclic fatigue behaviour of three commercial Si_3N_4 materials at room temperature. 1. HPSN with MgO and Al_2O_3 doping (bending vibration tests); 2. HPSN with Y_2O_3 and Al_2O_3 doping (cyclic tensile tests); 3. SSN with Yb_2O_3 and Al_2O_3 doping (bending vibration tests, static and cyclic tensile tests). New test techniques had to be created for the experiments, which were suitable both for alternating bending and for tensile/compressive vibration tests with threshold and alternating loads. The superimposed disturbing effects due to clamping had to be minimized for a statistical securing of the strength data. The aim of this work was the quantitative collection of fatigue data and working out a cyclic fatigue effect. From comprehensive investigations of the structure (LIM, REM, TEM), the fatigue mechanisms specific to the structure should be identified and proved. Accompanying this, comparative static fatigue and cyclic compressive vibration tests were carried out. (orig./MM).

6015 (INIS-mf–14099) **Influence of preparation technique of ceramic superconductors on structure, mechanical and electrical properties. Final report.** Tomandl, G.; Kohl, R. Erlangen-Nuernberg Univ., Erlangen (Germany). Inst. fuer Werkstoffwissenschaften; Bundesministerium fuer Forschung und Technologie, Bonn (Germany). 1991 113p. (In German). Contract BMFT 13N5498. Order Number DE93744508. Source: OSTI; NTIS (US Sales Only); INIS.

Sol-Gel-like preparation techniques using citrate-, citrate/ethylenglycol- as well as ethylhexanoate precursors and the addition of fluorine were tested with regard to homogeneity and properties of HTSC-ceramics. A few single- and polycrystalline materials were coated with YBaCuOxide- and Bi Sr Ca Cu Oxide-films

using ethylhexanoate-precursors. Interdiffusion reactions were investigated affecting the electrical properties. The best results in YBaCuOxide system were obtained using polycrystalline magnesia and silver as substrate materials. Bulk ceramics with a high degree of orientation were fabricated by reaction sintering and simultaneous external pressure. (orig.) With 44 refs., 6 tabs., 81 figs.

6016 (INIS-SU–323) **Thallium-bear high-temperature superconductors.** Tikhinskij, G.F. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (Russian Federation). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i. 1990. [32] (In Russian). Order Number DE93609000. Source: OSTI; NTIS (US Sales Only); INIS.

Thallium-bear oxide superconductors - are one of the latest achievements in the field of developing new compounds with laminated perovskyte structure, possessing high superconducting parameters. The given paper considers the main results of studying Tl-bear high-temperature superconductors (available in publications up to 1989), which analysis is necessary for selection of further development and study directions to produce high-conductivity wire. 54 refs.; 11 figs.; 3 tabs.

6017 (IS-M–729) **Growth of precipitates in $Bi_2Sr_2Ca_1Cu_2O_8$.** Xu, M. (Ames Lab., IA (United States)); Polonka, J.; Goldman, A.I.; Finnemore, D.K.; McKernan, S. Ames Lab., IA (United States). [1992]. 8p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract W-7405-ENG-82. (CONF-920916–3: 3. international conference and exhibition of the World Congress on Superconductivity, Munich (Germany), 14-19 Sep 1992). Order Number DE93004443. Source: OSTI; NTIS; INIS; GPO Dep.

In the formation of $Bi_2Sr_2Ca_1Cu_2O_8$ from a Ca and Cu rich melt, the partial pressure of oxygen is a central factor controlling the phases that form as precipitates in the host superconductor. At a high oxygen pressure, a sample with a stoichiometry of $Bi_2Sr_2Ca_2Cu_3O_{10}$ will form $(Sr,Ca)_2Cu_1O_3$ as the dominant precipitate coexisting with the liquid from which $Bi_2Sr_2Ca_1Cu_2O_8$ forms. During the crystallization of $Bi_2Sr_2Ca_1Cu_2O_8$ from this liquid, part of the $(Sr,Ca)_2Cu_1O_3$ phase is consumed. By contrast, at low oxygen partial pressure a sample with the same stoichiometry will form CaO as the dominant precipitate coexisting with the liquid from which $Bi_2Sr_2Ca_1Cu_2O_8$ forms. In this case, some of the CaO is consumed and a Ca rich $(Sr,Ca)_2Cu_1O_3$ phase forms during the $Bi_2Sr_2Ca_1Cu_2O_8$ crystallization. Oxygen partial pressure is a key factor controlling the sequence of precipitates that form in the host superconductor.The precipitate can serve as pinning sites for magnetic flux.

6018 (IS-T–1608) **New pathways to tungsten and molybdenum oxides, nitrides and azides.** Close, M.R. Ames Lab., IA (United States). 7 Oct 1992. 191p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-82. Order Number DE93003051. Source: OSTI; NTIS; GPO Dep.

$[WNCl_3]_4$ was prepared and characterized structurally by X-ray diffraction. $[WNCl_3]_4$ crystallizes in space group $P\bar{1}$ as planar 8-membered W-N rings interconnected through chloride bridges. The inter-tetramer linkage is weak and broken easily to accommodate basic ligands in the site trans to the W-N triple bond. Reactivity of $WNCl_3$, with nitriding agents, such as ammonia, trimethylsilylazide and lithium nitride, has been investigated, which resulted in preparation of new tungsten azido and nitrido compounds. Second, the reactivity of the metal dimers $MO_2(O_2CCH_3)_4$ and $MO_2Cl_4py_4$ with trimethylsilylazide has been explored, and the reactions in pyridine were found to yield a material corresponding to the formulation, $MoN(N_3)py$. Thermolytic decomposition of this azide at 280°C was performed under argon, dynamic vacuum or ammonia. Thermal decomposition in ammonia produces a molybdenum nitride relatively free of carbon with a Mo:N ratio of 1:1.8. $WNCl_3$ was converted into a hexagonal ammonium tungsten bronze, $(NH_4)_{0.28}WO_{3-y}(NH)_y$. This synthesis increased the probability of isoelectronic imido substitution for oxide in the bronze framework. Rietveld refinements of neutron powder data indicated strongly that nitrogen, in the form of imide, does not substitute for oxygen. A model for ammonium cation motion in the hexagonal channels of the bronze was developed. Electrical resistivity measurements on a pressed pellet of this hexagonal bronze show a temperature dependence like that of a low-band gap semiconductor, in contrast to conventionally prepared metallic hexagonal bronze phases.

6019 (KFK–4996) **Magnetic properties of superconducting $Y_1Ba_2[Cu_{1-x}Zn_x]_3O_7$.** Rudolf, B. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Technische Physik; Karlsruhe Univ. (T.H.) (Germany). Fakultaet fuer Physik. May 1992. 77p. (In German). Order Number DE93750399. Source: OSTI; NTIS (US Sales Only); INIS.

Grain aligned powder-samples of Zn doped YBaCuO ($x \leq 5\%$) have been investigated by measuring the dc-magnetization with a SQUID-magnetometer. Field dependend determination of the Meissner-fraction yields full bulk superconductivity for all samples (Meissner-fraction > 85% at B_e = 0,1G, referred to ideal shielding). Sinter-samples, however, allow only uncertain estimations of the superconducting volume fraction (Meissner-fraction < 40% at B_e > 0,01G). The magnetic penetration depths are determined by the analysis of the temperature dependence of the magnetization at low magnetic fields. With increasing Zn-concentration there is a strong increase of λ_{ab} and λ_c while the anisotropy λ_c/λ_{ab} decreases. These effects are supported by the analysis of the reversible magnetization at high fields (B_e > 1T). The experimental findings (concentration dependency of λ, Tc, Δc_p and $\rho(T)$) are in good agreement with theoretical predictions on gapless-superconductivity and therefore give strong evidence that the substitution of Cu by Zn leads to gapless-superconductivity. (orig.).

6020 (KFK–5070) **Effects in thin films of the high-T_c compounds REBaCuO induced by ion irradiation.** Kroener, T. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Nukleare Festkoerperphysik; Karlsruhe Univ. (T.H.) (Germany). Fakultaet fuer Physik. Sep 1992. 132p. (In German). Order Number DE93744817. Source: OSTI; NTIS (US Sales Only); INIS.

The objective of this work was to study the behaviour of thin films of the REBaCuO-system under ion irradiation. For this films of different growth directions ([100], [001] and [110]) were irradiated with H^+-, He^+- and Ar^{++}-ions at room temperature (RT). The samples were characterized by resistive measurements and X-ray and electron diffraction. For irradiation experiments at low fluences a decrease of the transition temperature T_c to superconductivity and a broadening of the transition width ΔT_c were observed. At the latest at a dpa of 0.07 the samples showed no entrance to superconductivity. With increasing fluence a metal-insulator transition was observed. The specific resistance ρ (100 K) revealed an exponential increase with fluence for all ions used. The formation of a until now unknown superstructure in irradiation a-axis films was observed. It is a $\sqrt{2}\ a_c \times \sqrt{2}\ a_c \times 3a_c$ ($a_c \simeq 3.8$ A)-structure which arises by a new ordering of the O(4) atoms in the basal plane of the '123'-structure. Correspondences between the increase of the lattice parameters a and c after irradiation and their values before irradiation were found. With increasing fluence an increase of the strains in the films were observed which leads to the occurrence of partial amorphization of the films. For irradiations with He^+- and Ar^{++}-ions the samples were fully amorphized at a dpa of 0.2. For irradiations with protons an equilibrium between the defect production and an annealing of the defects occurred at an amorphization level of 80%. (orig./MM).

6021 (LA–12392-MS) **Comparative cost analysis of ceramic processing techniques.** Howe, P.M. Los Alamos National Lab., NM (United States). Sep 1992. 43p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93003047. Source: OSTI; NTIS; GPO Dep.

We made a comparative cost analysis of several processing techniques conventional gas-furnace sintering, electric kiln sintering, microwave sintering, and hot pressing-used for making oxide and nonoxide ceramic parts. It was found that microwave sintering of nonoxide ceramics offers a major economic advantage over hot pressing. This advantage (cost reduction by a factor of four or larger) is primarily a result of higher throughputs. The cost advantage is increased by low material costs and microwave sintering to near-net shape. The estimated cost saving is not sensitive to changes in estimated throughputs for microwave sintering. The estimated cost saving is very sensitive to changes in the throughput

for hot pressing, as pressing rates are typically very low. For oxides, microwave sintering does not currently offer a clear economic advantage over conventional gas or electric kilns. Neither electric kilns nor microwave systems have the high-volume effluent problem that gas kilns have. Under conditions where tight control of effluents is required for environmental reasons, gas-fired kilns may be significantly more expensive. Because close control over processing factors is required for high yields, microwave technology should provide a strong advantage where product specifications are very demanding. Even tighter process control should be attainable through a combination of microwave and conventional heating. Product yield in the sintering step exerted the greatest influence upon total part cost of any factors investigated because yield affects the total cost as a multiplicative factor. Of the additive inputs investigated, control of material costs offered the greatest opportunity for additional cost saving.

6022 (LA-UR–92-3702) **Interfacial structure of Si_3N_4 brazed with a Ag-Cu-Ti alloy.** Suematsu, H. (Los Alamos National Lab., NM (United States)); Petrovic, J.J.; Mitchell, T.E.; Yano, T. Los Alamos National Lab., NM (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-921128–4: Ceramic science and technology congress and exposition, San Francisco, CA (United States), 1-4 Nov 1992). Order Number DE93003777. Source: OSTI; NTIS; GPO Dep.

Single crystal Si_3N_4 was brazed using a Ag-Cu eutectic alloy containing 2% Ti at 950°C for 30min and the interface was observed by high resolution electron microscopy. A layer of reaction products is formed between the Si_3N_4 and the brazed metal. TiN and Ti_2N are formed near the interface; however, only TiN is found at the interface in contact with the Si_3N_4. A crystallographic orientation relationship was found between the TiN and Si_3N_4 in which the N atoms are shared between the two structures with little distortion.

6023 (LA-UR–92-3752) **Development of Bi-2223 tapes for conductor applications.** Willis, J.O.; Peterson, D.E.; Salazar, K.V.; Coulter, J.Y.; Maley, M.P.; Bingert, J.F.; Phillips, D.S.; Kung, P.J. Los Alamos National Lab., NM (United States). [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-921124–1: 5. international symposium on superconductivity, Kobe (Japan), 16-19 Nov 1992). Order Number DE93003826. Source: OSTI; NTIS; GPO Dep.

A description is given of the oxide powder in silver tube process for Bi-2223 phase high temperature superconductor tapes. Results of materials and electrical property measurements define the critical issues for high critical current density tapes to be the production of uniform, chemically homogeneous tape cores which together with careful thermomechanical processing result in conductors with a high degree of texture and small number of deleterious microcracks.

6024 (LA-UR–92-3808) **Local vibronic and electronic excitations of doping-induced states in the copper oxides.** Yonemitsu, K. (Los Alamos National Lab., NM (United States)); Bishop, A.R.; Lorenzana, J. Los Alamos National Lab., NM (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9211133–1: 2. Cinvestav superconductivity symposium, Tequisquiapan (Mexico), 2-6 Nov 1992). Order Number DE93003844. Source: OSTI; NTIS; GPO Dep.

Doping states in the copper oxides are investigated in a two-dimensional, three-band Peierls-Hubbard model. We consider displacements of planar O atoms along the Cu-O bonds, and focus on intersite electron-phonon interactions modifying the hopping integral between the Cu and O orbitals. Hartree-Fock configurations of polaronic states in the antiferromagnetic background are sensitively affected by weak electron-phonon interaction. Vibronic and optical excitation spectra, obtained with the random phase approximation, contain doping-induced structures caused by excitation modes localized around the polarons. A dimensionless strength of the electron-phonon interaction is deduced from a comparison with recent generalized inhomogeneous LDA calculations. The nature of doping states is quite different from that described within purely electronic, Hubbard and t-J models.

6025 (LBL–32828) **Oxygen configurations and their effect on charge transfer in $YBa_2Cu_3O_z$.** McCormack, R. (Lawrence Berkeley Lab., CA (United States)); Fontaine, D. de; Ceder, G. Lawrence Berkeley Lab., CA (United States). Apr 1992. 7p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract AC03-76SF00098. Contract DAAL03-91-G-0268. (CONF-920402–61: 1992 Material Research Society (MRS) spring meeting, San Francisco, CA (United States), 27 Apr - 2 may 1992). Order Number DE93002543. Source: OSTI; NTIS; GPO Dep.

The relationship between oxygen structure, charge transfer (hole count), and oxygen content in the $YBa_2Cu_3O_z$ superconductor is studied by combining Monte-Carlo simulation with existing electronic structure calculations. The present model proposed an expansion of the hole count in terms of oxygen configuration variables for states of an arbitrary degree of order. Calculations of hole count as a function of oxygen content suggest that oxygen ordering is, at least in part, responsible for the observed plateau structure of T_c vs. oxygen content z.

6026 (SAND–92-0484) **Hydrostatic and triaxial compression experiments on unpoled PZT 95/5-2Nb ceramic: The effects of shear stress on the $F_{R1} \rightarrow A_O$ polymorphic phase transformation.** Zeuch, D.H.; Montgomery, S.T.; Keck, J.D.; Zimmerer, D.J. Sandia National Labs., Albuquerque, NM (United States). Oct 1992. 164p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93003233. Source: OSTI; NTIS; GPO Dep.

Hydrostatic and constant-stress-difference (CSD) experiments were conducted at RT on 3 different sintering runs of unpoled, Nb-doped lead-zirconate-titanate ceramic (PZT 95/5-2Nb) in order to quantify influence of shear stress on displacive, martensitic-like, first-order, rhombohedral → orthorhombic phase transformation. In hydrostatic compression at RT, the transformation began at about 260 MPa, and was usually incompletely reversed upon return to ambient. Strains associated with the transformation were isotropic, both on first and subsequent hydrostatic cycles. Results for CSD tests were quite different. First, the confining pressure and mean stress at which the transition begins decreased linearly with increasing stress difference. Second, the rate of transformation decreased with increasing shear stress and the accompanying purely elastic shear strain. This contrasts with the typical observation that shear stresses increase reaction and transformation kinetics. Third, strain was not isotropic during the transformation: axial strains were greater and lateral strains smaller than for the hydrostatic case, though volumetric strain behavior was comparable for the two types of tests. However, this effect does not appear to be an example of true transformational plasticity: no additional unexpected strains accumulated during subsequent cycles through transition under nonhydrostatic loading. If subsequent hydrostatic cycles were performed on samples previously run under CSD conditions, strain anisotropy was again observed, indicating that the earlier superimposed shear stress produced a permanent mechanical anisotropy in the material. The mechanical anisotropy probably results from a "one-time" crystallographic preferred orientation that developed during the transformation under shear stress. Finally, in a few specimens from one particular sintering run, sporadic evidence for a "shape memory effect" was observed.

6027 (SAND–92-0914C) **X-ray diffraction study of shock-modified tetragonal phases of SnO_2 and MnO_2.** Newcomer, P.; Morosin, B.; Graham, R.A. Sandia National Labs., Albuquerque, NM (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9208129–8: Annual Denver x-ray conference, Denver, CO (United States), 3-7 Aug 1992). Order Number DE93002488. Source: OSTI; NTIS; GPO Dep.

X-ray diffraction line-profile analysis on tetragonal forms of Sn02 (cassiterite), Mn02 (pyrolusite), and previously studied Ti02 (rutile), which were subjected to high pressure shock loading, show that residual lattice strain and coherent "crystal" size are a function of shock parameters. An interesting observation on sample of Mn02 concerns the recovery of cubic Mn203 (bixbyite) in the material subjected to 22 GPa, indicating a shock-induced chemical synthesis.

6028 (UCRL–53943-91, pp. 96-98) **Magnetic and transports properties of some high-temperature superconductors.** Liu, J.Z. (Univ. of California, Davis (United States)); Zhang, L.; Jia, Y.X.; Lan, M.D.; Klavins, P.; Shelton, R.N. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

The authors measured magnetic and transport properties of single crystals of $Bi_{1.7}Pb_{0.3}Sr_2CaCu_2O_8$ (BPSCCO) and $Y_{1-x}Pr_xBa_2Cu_3O_7$ (YBCO-Pr) over wide temperature and field ranges. They determined important thermodynamic properties, such as the Ginzburg-Landau parameter k, orbital critical field H_{c2}, and coherence length ξ.

6029 (UCRL–53943-91, pp. 176-178) **LLNL/UC Davis high-T_c collaboration: Highlights of the University program.** Shelton, R.N. (Univ. of California, Davis (United States)). Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

LLNL and UC Davis have completed the third year of a collaborative research program that focuses on high-temperature, superconducting materials. Emphasizing experimental work, individual projects have covered the spectrum from investigations of the intrinsic origins of high-T_c superconductivity to experiments with a strong orientation toward applications and device fabrication.

6030 **Production of supraconducting oxide layers with the sol-gel-dipping method. Final report.** Frischat, G.H. Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany). Inst. fuer Nichtmetallische Werkstoffe; Bundesministerium fuer Forschung und Technologie, Bonn (Germany). [1991] 15p. (In German). Contract BMFT 13N5693. (INIS-mf–14086). Source: OSTI.

The aim of the project was to produce thin layers which act as high-temperature supraconductors according to the alkoxide method and to characterise them. (MM).

3606 Other Materials

Refer also to citation(s) 5141, 5237, 5272, 5274, 5824, 5825, 5925, 5926, 6009, 6010, 6029, 6123, 6127, 6136, 6161, 6169, 6248, 6262, 6263, 6268, 6269, 6427, 7128, 7257, 7326, 7327, 7328, 7329, 7330, 7411, 7509

6031 (ANL/CHM/CP–76424) **Various unique vacuum holders.** Gregar, J.S. Argonne National Lab., IL (United States). [1992]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9206319–1: 37. annual symposium of the American Scientific Glassblowers Society (ASGS), Dearborn, MI (United States), 21-26 Jun 1992). Order Number DE93004121. Source: OSTI; NTIS; GPO Dep.

Glassblowers use vacuum holding devices to support a flat plate in the glassflowing lathe to seal onto the end of, or inside of, a glass cylinder. Glassblowing blowhose swivels tend to leak; a rotating union from the hydraulics industry is better. Various graphite holder designs are described.

6032 (ANL/CP–75338) **Erosion of composite ceramics.** Routbort, J.L. Argonne National Lab., IL (United States). Aug 1992. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-921147–1: 8. international symposium on ceramics and 2nd national conference on advanced ceramics and exhibition on new ceramic materials, Rimini (Italy), 9-13 Nov 1992). Order Number DE93004254. Source: OSTI; NTIS; GPO Dep.

The theoretical basis to describe solid-particle erosion of monolithic ceramics is well developed. In many cases, the models can account for the impact velocity, impact angle and erodent-size dependencies of the steady-state erosion rate. In addition, the models account for effects of materials parameters such as fracture toughness and hardness. Steady-state erosion measurements on a wide variety of composite ceramics, including SiC whisker-reinforced Al_2O_3, Si_3N_4 containing Si_3N_4 or SiC whiskers, Y_2O_3-stabilized ZrO_2 reinforced with SiC whiskers, and duplex-microstructure Si_3N_4 have been reported. The theories developed for monolithic ceramics are, however, less successful in describing the results for composites.

6033 (ANL/CP–75819) **An acousto-ultrasonic NDE technique for monitoring material anisotropy.** Chien, Hual Te; Sheen, Shuh Haw; Raptis, A.C. Argonne National Lab., IL (United States). Aug 1992. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9207155–2: Quantitative nondestructive evaluation conference, San Diego, CA (United States), 19-24 Jul 1992). Order Number DE93002994. Source: OSTI; NTIS; GPO Dep.

A simpler and better way of monitoring the anisotropy of fiber-reinforced composite materials, based on the acousto-ultrasonic approach, is presented. In this approach, time of flight of the acousto-ultrasonic waves AU, rather than the stress wave factor, is measured. Two fundamental Lamb modes are generated under the first critical frequency: one is the first antisymmetric mode traveling with a slower velocity while the another is the first symmetric mode traveling with a faster speed. The later one is sensitive to the azimuthal angle and nearly nondispersive, and has a phase velocity very close to that of the bulk longitudinal wave of the material. Experimental data measured from two methods, TOF measurement and slope method, are compared with theoretical results; a good agreement is obtained for monitoring the material anisotropy. There is a great potential for this AU approach in material-property evaluation and in quantitative measurements of defects and debonding of fiber-reinforced composites. However, more studies are needed to better understand the effect of the fiber/matrix bonding on the measurements and to extract more information from the AU signals.

6034 (ANL/CP–76341) **Neutron study of crystal-field transitions in $ErPO_4$.** Loong, C.-K. (Argonne National Lab., IL (United States)); Soderholm, L.; Hammonds, J.P.; Abraham, M.M.; Boatner, L.A.; Edelstein, N.M. Argonne National Lab., IL (United States). [1992]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-921201–8: Conference on magnetism and magnetic materials, Houston, TX (United States), 1-4 Dec 1992). Order Number DE93004131. Source: OSTI; NTIS; GPO Dep.

The crystal-field splitting of the Er^{3+} ground multiplet, $^4I_{15/2}$, in $ErPO_4$ is investigated by inelastic neutron scattering. Four excitations from the Γ_7 ground state to the excited states and several transitions between the excited states have been identified. The observed transition energies and intensities are used to refine the parameters of the crystal-field potential. The calculated magnetic susceptibility, $\chi(T)$, agrees well with experimental values from single-crystal measurements. A comparison of the neutron data with optical absorption and both nonresonance and resonance Raman scattering measurements has been made.

6035 (ANL/CP–77428) **Application of neutron diffraction technology to the determination of residual strain in engineering composites.** Kupperman, D.S. Argonne National Lab., IL (United States). [1992]. 19p. Sponsored by National Aeronautics and Space Administration, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-921110–37: Winter annual meeting of the American Society of Mechanical Engineers (ASME), Anaheim, CA (United States), 8-13 Nov 1992). Order Number DE93004249. Source: OSTI; NTIS; GPO Dep.

Knowledge of fabrication induced residual stresses in the fiber and matrix of advanced engineering composites is important as these stresses can greatly influence the mechanical properties of these composites. In this paper, the application of neutron diffraction technology to the determination of thermal residual strains in the constituents of composites (from which stresses can be calculated) is discussed. Experimental determination of temperature dependent strain in the fiber and matrix of three composites compare favorably with the results of analytical and finite element methods used to predict strain. These composites (two ceramic matrix and one metal matrix) are materials of interest to a variety of industries. In this paper, the benefit of applying a National Laboratory developed technology to a problem of interest to industry, is shown.

6036 (ANL/MCT/CP–77573) **Use of volume x-ray tomography for characterizing density variations in as-cast ceramic**

bodies. Ellingson, W.A. (Argonne National Lab., IL (United States)); Holloway, D.L.; Sivers, E.A.; Ling, J.; Pollinger, J.P.; Yeh, H.C. Argonne National Lab., IL (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-921110–32: Winter annual meeting of the American Society of Mechanical Engineers (ASME), Anaheim, CA (United States), 8-13 Nov 1992). Order Number DE93002906. Source: OSTI; NTIS; GPO Dep.

A joint project is ongoing to evaluate nondestructive characterization (NDC) methods to detect and measure process-induced variations in ceramic materials. The process methods of current focus are slip-casting and injection molding, and a primary NDC method being evaluated is microfocus X-ray computed tomography (XCT). SiC-whisker-reinforced Si_3N_4 has been pressure-slip-cast at two casting pressures, 0.103 and 0.276 MPa (15 and 40 psi); and at length/diameter ratios of 1.5, and 2.67 with whisker contents of 20, 23, 27, and 30 wt.%. Three-dimensional microfocus XCT has been used to study density variations in billets produced by different process conditions. Destructive measurement of density variation has been compared to the XCT measurements and correlations have been established. XCT has been proven (by destructive verification) to be capable of detecting <5% variations in as-cast density.

6037 (ANL/MSD/CP–75815) **Liquid tellurides: Structure and properties.** Saboungi, M.L. (Argonne National Lab., IL (United States)); Fortner, J.; Richardson, J.W.; Petric, A.; Doyle, M.; Enderby, J.E. Argonne National Lab., IL (United States). Oct 1992. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9208177–1: 8. international conference on liquid and amorphous metals, Wien (Austria), 31 Aug - 4 sep 1992). Order Number DE93002909. Source: OSTI; NTIS; GPO Dep.

In this paper a review of the thermodynamic, electrical and structural properties of liquid alkali-tellurium alloys is presented with a special emphasis on the interplay between these properties. The thermodynamic properties indicate ordering of the solutions at compositions corresponding to about 12, 50, and 67 atom% of alkali atoms. The electrical conductivity and thermopower data confirm that these liquids are true semiconductors. The neutron diffraction patterns coupled with the above information indicate that in the case of liquid $K_{0.12}Te_{0.88}$ the measured structure is dominated by the Te-Te contribution, and is remarkably similar to that of pure liquid tellurium, while the equiatomic alloy $K_{0.50}Te_{0.50}$ is shown to contain mostly Te pairs which are identified with Zintl ions, Te_2^{2-}.

6038 (ANL/MSD/CP–77704) **Weak ferromagnetism in κ-$(ET)_2Cu[N(CN)_2]Cl$.** Welp, U. (Argonne National Lab., IL (United States)); Kwok, W.K.; Crabtree, G.W.; Carlson, K.D.; Wang, H.H.; Geiser, U.; Williams, J.M.; Fleshler, S.; Hitsman, V.M. Argonne National Lab., IL (United States). Oct 1992. 4p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract W-31109-ENG-38. Contract STC-8809854. (CONF-9209202–3: International conference on strongly correlated electron systems, Sendai (Japan), 7-11 Sep 1992). Order Number DE93002983. Source: OSTI; NTIS; GPO Dep.

We present magnetization measurements at ambient pressure on κ-$(ET)_2Cu[N(CN)_2]Cl$, an organic salt that is superconducting under pressure (T_c= 12.8 K at 0.3 kbar). An antiferromagnetic transition near 45 K and, for the first time in this class of materials, a transition near 22 K to a state displaying weak ferromagnetic hysteresis with a saturation moment of 8 x 10^{-4} μ_B/formula are observed. This low temperature state is characterized by a sequence of first order magnetization jumps.

6039 (BNL–48012) **Noble gas incorporation in sputtered and ion beam assisted grown silicon films.** van Veen, A. (Technische Hogeschool Delft (Netherlands). Inter-Faculty Reactor Inst.); Greuter, M.J.W.; Niesen, L.; Nielsen, B.; Lynn, K.G. Brookhaven National Lab., Upton, NY (United States). [1991]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-910406–42: Spring meeting of the Materials Research Society (MRS), Anaheim, CA (United States), 29 Apr - 3 may 1991). Order Number DE93002330. Source: OSTI; NTIS; INIS; GPO Dep.

Gas desorption measurements have been performed on sputter deposited silicon films. The sputter gas was argon or krypton. Parameters influencing the incorporation process e.g. bias voltage, substrate temperature and arrival rate ratio of silicon and noble gas atoms have been systematically varied. The films, a-Si and c-Si, have been characterised by various techniques for composition and defect analysis. A model has been applied to describe the composition of the growing silicon layer. Underlying mechanisms like gas-gas sputtering have been studied in separate ion implantation experiments. For a-Si concentrations as high as 6% Ar and Kr have been found. An important effect is the injection of self-interstitial atoms caused by the low energy heavy ion bombardment. It causes the layer to grow without large open volume defects.

6040 (CONF-8909210–, pp. 1-7) **Localized elastic and inelastic scattering processes for electrons in multilayer structures.** Howie, A. (Cavendish Lab., Cambridge (United Kingdom)); Walsh, C.A.; Wang, Z.L. Oak Ridge National Lab., TN (United States). Apr 1990. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

Characterization of the microstructure of many modern composite materials depends on development and efficient use of new elastic and inelastic electron scattering processes which yield a high degree of spatial localization. This is illustrated with reference to recent studies of semiconductor multilayer systems as well as natural layered crystals. Reflection electron microscopy (REM) imaging at grazing angles has been pursued here, combined with reflection energy loss spectroscopy using STEM. These methods have been applied to samples of GaAs/AlAs multilayers cleaved in such a way as to permit some transmission imaging and valence loss spectroscopy as well. They also report REM valence loss spectroscopy and SE imaging of cleaved surfaces of alumina which are a kind of natural ultrafine multilayer sample. In reflection studies surface oxidation or damage seriously complicates the results.

6041 (CONF-8909210–, pp. 25-33) **Electron microscopy study of the electronic properties of small silicon particles.** Ugarte, D. (Univ. Paris XI, Orsay (France)); Colliex, C.; Trebbia, P. Oak Ridge National Lab., TN (United States). Apr 1990. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

The problem of the energy lost by a fast electron interacting with a small particle has been studied for many years. Small objects have shown a behavior substantially different from bulk materials. Moreover the electronic properties of small particles are very important from a technological point of view because of their possible application in catalysis. Although many of the theoretical formalisms developed for small spheres are generally valid for any arbitrary dielectric function, the STEM experimental measurements have dealt mostly with metals, and their dielectric constants were usually modelized by the Drude expression for a free electron gas. The aim of this work is to test the validity of the classical dielectric theory for a more complex case. Here, the authors will be concerned with the electronic properties of spherical silicon particles. This material and its oxides are very well characterized, because of their applications in microelectronics. The dielectric properties of Si and its oxides (SiO_2, SiO) present complex structures, and provide a stringent test of the theory developed up to now. They study in a STEM the low energy loss spectrum of silicon particles, and also the spatial localization of the most important spectral features observed, using digitally acquired energy filtered images. The results are compared to the predictions of the classical dielectric theory. An anomalous peak at 3-4 eV is observed at the outermost surface of the SiO_2 layer surrounding the particles. They conclude that this phenomenon is due to a beam induced process, which renders the SiO_2 surface conducting. They modelize this effect by including a very thin coating of amorphous silicon, supposed to be produced by electron induced oxygen desorption. The theoretical spectra and images then fit the experimental results correctly.

6042 (CONF-8909210–, pp. 273-288) **Radiative electron capture by channeled ions.** Pitarke, J.M. (Euskal Herriko Unibertsitatea, Bilbo (Spain)); Ritchie, R.H. Oak Ridge National Lab., TN (United States). Apr 1990. DOE Contract AC05-84OR21400. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

Considerable experimental data have been accumulated relative to the emission of photons accompanying electron capture by swift, highly stripped atoms penetrating crystalline matter under channeling conditions. Recent data suggest that the photon energies may be less than that expected from simple considerations of transitions from the valence band of the solid to hydrogenic states on the moving ion. The authors have studied theoretically the impact parameter dependence of the radiative electron capture (REC) process, the effect of the ions wake and the effect of capture from inner shells of the solid on the photon emission probability, using a statistical approach. Numerical comparisons of the results with experiment are made.

6043 (CONF-921119–1) **A performance model for thick composite cylinders subjected to external hydrostatic pressure.** Starbuck, J.M.; Blake, H.W. Oak Ridge National Lab., TN (United States). [1992]. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From American Society for Testing and Materials (ASTM) symposium on application of accelerated corrosion tests to life prediction of materials; Miami, FL (United States); 16-17 Nov 1992. Order Number DE93002425. Source: OSTI; NTIS; GPO Dep.

Experimental results from implosion tests of various graphite/epoxy and glass/epoxy cylinders are correlated with predictions from a performance model for thick composite cylinders subjected to external hydrostatic pressure. The performance model consists of a stress module a stability module, and a material failure module. The stress module predicts the ply level stresses and is based on an anisotropic elasticity solution for axisymmetric loading. The stability module predicts the critical buckling load based on a laminated orthotropic shell theory which includes transverse shear deformations. The failure module evaluates several existing failure criteria for composite laminates. The results from the correlation study led to the selection of an appropriate failure theory for thick laminated composite cylinders loaded in compression. Results from the Hashin criteria are seen to be consistent with observed experimental results provided that composite material strength allowables are based on representative test and that appropriate solutions for cylinder stresses are used. Both the failure criteria and stress solution must allow for the three-dimensional stress state and for the discrete layer construction Further applications of the performance model are demonstrated for a range of laminate constructions. These parametric studies provide insight to optimum designs for graphite/epoxy and glass/epoxy cylinders.

6044 (DOE/CE/23810–4A) **Thermophysical properties: Quarterly report, 1 July 1992–30 September 1992.** Kayser, R.F. National Inst. of Standards and Technology, Gaithersburg, MD (United States). Thermophysics Div.; Air-Conditioning and Refrigeration Technology Inst., Inc., Arlington, VA (United States). Oct 1992. 101p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91CE23810. Order Number DE93006427. Source: OSTI; NTIS; GPO Dep.

Numerous fluids have been identified as promising alternative refrigerants, but much of the information needed to predict their behavior as pure fluids and as components in mixtures does not exist. In particular, reliable thermophysical properties data and models are needed to predict the performance of the new refrigerants in heating and cooling equipment, and to design and optimize equipment to be reliable and energy efficient. Objective of this project is to provide highly accurate, selected thermophysical properties data for Refrigerants 32, 123, 124, and 125, and to use these data to fit simple and complex equations of state and detailed transport property models. The new data will fill gaps in the existing data sets and resolve the problems and uncertainties that exist in and between the data sets. This report describes the progress made during the third quarter of this fifteen-month project, which was initiated in late January, 1992.

6045 (DOE/CE/23810–4C) **Compatibility of refrigerants and lubricants with elastomers: Quarterly report, 1 July 1992–30 September 1992.** Hamed, G.R.; Seiple, R.H. Akron Univ., OH (United States). Inst. of Polymer Science. Oct 1992. 140p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91CE23810. Order Number DE93006429. Source: OSTI; NTIS; GPO Dep.

Information contained in this report is designed to assist the air-conditioning and refrigeration industry in the selection of suitable elastomeric gasket and seal materials that will prove useful in various refrigerant and refrigeration lubricant environments. 97% of the swell measurements have been made to date. The other 3% of the measurements are contingent on the availability of additional quantities of R-32. Swell behavior in the fluids have been determined using weight and in situ diameter measurements for the refrigerants and weight, diameter and thickness measurements for the lubricants. Weight and diameter measurements are repeated after 2 hours and 24 hours for samples removed from the refrigerant test fluids and 24 hours after removal from the lubricants.

6046 (DOE/CE/40917–T2) **Development of an advanced glass melting system: The Thermally Efficient Alternative Melter, TEAM: Phase 1, Final report.** Air Products and Chemicals, Inc., Allentown, PA (United States). Feb 1992. 132p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-89CE40917. Order Number DE93005211. Source: OSTI; NTIS; GPO Dep.

Purpose is to develop a next generation glass melting process that will increase the competitiveness of the U.S. glass industry through reduced energy consumption, production cost, and environmental impact. This process will increase the thermal efficiency of glass manufacturing while reducing emissions by combining oxygen fuel fired glass melting with heat recovery. If 76% of the 20 million tons of glass made annually in USA were produced with the TEAM process, 23% of the energy (16.5 trillion Btu/y) at the glass melter boundary would be saved; $158 million/y would be saved; NO_x emissions would be reduced by 87%; SO_x emissions by 42%; CO_2 emissions by 20%; particulates by 74%; 3,000 tons/y of hazardous refractory waste would be eliminated; and 200-300 jobs would be saved. In this Phase 1, three primary heat recovery techniques were identified that were combined with oxygen fuel fired glass melting in six different processes: natural gas reformation, gas turbine cycles, and raw materials preheating. Of the six processes evaluated, the one with natural gas reformation offers the lowest production cost with high fuel efficiency, low environmental impact, and least mechanical complexity. It can be used in ferrous and nonferrous metallurgical process such as steel soaking pits and scrap aluminium melting, and other minerals processes such as Portland cement and glass frit manufacture.

6047 (DOE/ER/14130–2) **Aluminum coordination and active sites on aluminas, Y zeolites and pillared silicates: Progress report, January 31, 1992–January 31, 1993.** Fripiat, J.J. Wisconsin Univ., Milwaukee, WI (United States). [1992]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER14130. Order Number DE93006183. Source: OSTI; NTIS; GPO Dep.

Effort was continued to characterize the nature of the Al species responsible for Lewis acidity in zeolites and in aluminas by NMR. While numerous techniques have been successful for scaling the acid strength of Broensted sites, the situation is not satisfactory for the Lewis acid sites. Initial rate of dehydrochlorination of 1,1,1-trichloroethane is sensitive to strength of Lewis acid sites. N-Butene isomerization has been extended to the new aluminas obtained from nano-sized precursors. O-Xylene isomerization was carried out in a recirculation reactor on H-mordenite samples containing Lewis or Broensted acid sites; effects of H_2 and NO were also investigated. Cracking of methylcyclohexane and 3-methylpentane was investigated by EPR on H-mordenite. Sepiolite, a Mg silicate with zeolitic channels, had Al substituted for Si; the negative charge is balanced by, say, VO^{2+}. Transformation of ethanol into butadiene on this dual-function catalyst appears to result from a

Prins reaction between acetaldeyde formed on the redox sites and ethylene resulting from dehydration of ethanol on Lewis sites.

6048 (DOE/ER/45404–3) **Theoretical models for the ultimate strength and flaw resistance of unidirectionally-reinforced ceramic-matrix composites: Progress report, September 1989–August 1992.** Steif, P.S. Carnegie-Mellon Univ., Pittsburgh, PA (United States). Dept. of Mechanical Engineering. [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-89ER45404. Order Number DE93005881. Source: OSTI; NTIS; GPO Dep.

Progress is reported on (1) interpretation of interface tests; (2) the effect of interface properties on flexural strength and its connection with uniaxial tensile strength, and (3) effect of interface properties on uniaxial tensile strength. Goal is to establish relations between manipulable material variables and mechanical response. The approach has been: (i) to hypothesize as to the key underlying physical mechanisms and to represent these hypotheses with model theoretical problems which can relate material parameters to observed mechanical behavior, (ii) to develop the necessary techniques to analyze the model problems; and (iii) to test the models by comparing the obtained results with experimental data. Phases 1 and 2 have been brought to satisfactory completion; work remains to be done on the third phase.

6049 (DOE/NASA/0030–9) **Tribological and microstructural investigation of the PM200 series of self-lubricating composites.** Bogdanski, M.S. National Aeronautics and Space Administration, Cleveland, OH (United States). Lewis Research Center; Case Western Reserve Univ., Cleveland, OH (United States). Nov 1992. 71p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI01-91CE50306. (NASA/CR–190772). Order Number DE93003887. Source: OSTI; NTIS; GPO Dep.

This master's thesis describes an investigation of the effects of processing and compositional variations on the tribological, microstructural, and compressive strength characteristics of PM212. PM212 is a self-lubricating composite, comprised of a wear-resistant metal bonded (NiCo) chromium carbide matrix, containing the solid lubricants barium fluoride/calcium fluoride eutectic and silver. Several alternate composites were formulated which had lubricant and matrix variations. Processing variations included sintering and hot isostatic pressing (HIPping). Pin-on-disk tests were used to screen the alternates for friction and wear properties. Several of the chromium carbide-based self-lubricating composites exhibited low friction and wear in sliding against a nickel-based superalloy. One specific composition contained gold in place of silver to minimize the potential reactivity of the composite with possible environmental contaminants such as sulfur. This formulation also resulted in a composite with good tribological properties. Results indicate that several of these composites have potential use as sliding bearing and seal materials in operation from 25°C to temperatures as high as 900°C. The good tribological performance by several different composites showed that the composition of PM212 can be altered without dramatically affecting performance.

6050 (ETDE-mf–93744397) **Magneto-optical measurements of the spatial distribution of point defects in semi-insulating GaAs. Final report.** Spaeth, J.M.; Hofmann, D.M.; Krambrock, K. Paderborn Univ. (Gesamthochschule) (Germany). Fachbereich 6 - Physik; Bundesministerium fuer Forschung und Technologie, Bonn (Germany). 1991 18p. (In German). Contract BMFT NT2716A/NT2766A. Order Number DE93744397. Source: OSTI; NTIS (US Sales Only).

The homogeneity of the electrical properties of semi-insulating (s.i.) GaAs depends on the spatial distribution of intrinsic and extrinsic point defects. For the s.i. properties of undoped GaAs is responsible mainly the deep donor EL2, which has a diamagnetic ($EL2^0$) and a paramagnetic ($EL2^+$) charge state and which compensates intrinsic acceptors and the impurity acceptors C and Zn. For the determination of the concentration and the spatial distribution of $EL2^+$ and $EL2^0$ an apparatus to measure the optical magnetic circular dichroism and the optical absorption with a spatial resolution of about 30 μm is developed. Older LEC-grown GaAs wafer show variations of $EL2^0$ and $EL2^+$ of up to $\pm$ 50% with an anticorrelation of $EL2^0/EL2^+$, while recently grown LEC wafers show only variations of $\pm$ 10-15%. The annealing procedures 'A' and 'B' (Wacker) have a strong effect to homogenise $EL2^+$. There the concentration if $EL2^+$ is about an order of magnitude smaller compared to that of $EL2^0$. Rapid thermal annealing procedures have no significant effect on the EL2-distribution. Intrinsic acceptors are formed with varying total concentrations, partly very low, partly up to $5x10^{15}cm^{-3}$. It is shown, that $EL2^+$-concentrations cannot be determined at the reliable way from IR absorption measurements. (orig.) With 15 refs., 3 tabs., 7 figs.

6051 (ETDE-mf–93744519) **Adhesive strength, intrinsic stress and corrosion of mixed layers. Partial report.** Barth, M. (Heidelberg Univ. (Germany). Physikalisch-Chemisches Inst.); Ensinger, W.; Messina, D.; Schroeer, A.; Wolf, G.K.; Rueck, D.; Spaetdke, P.; Wituschek, H.; Wolf, B. Heidelberg Univ. (Germany). Physikalisch-Chemisches Inst. [1992] 19p. (In German). Contract BMFT 13N5428. Order Number DE93744519. Source: OSTI; NTIS (US Sales Only).

This intensive report presents findings on ion-beam-supported coating with chromium nitride, TiN, and TiC. The influence of the main process parameters on the hardness and structure of Cr_2N, TiC, and TiN is pointed out, as well as the protective effect of chromium nitride, TiN, and TiC. (MM).

6052 (IEN–36/92) **Molecular dynamical and structural studies for the bakelite by neutron cross section measurements.** Voi, D.L. Instituto de Engenharia Nuclear (IEN), Rio de Janeiro, RJ (Brazil). May 1992. [54] (In Portuguese). Order Number DE93609444. Source: OSTI; NTIS (US Sales Only); INIS.

Neutron reaction cross sections were determined by transmission and scattering measurements, to study the dynamics and molecular structure of calcined bakelites. Total cross sections were determined, with a deviation smaller than 5%, from the literature values, by neutron transmission method and a specially devised approximation. These cross sections were then correlated with data obtained with infra-red spectroscopy, elemental analysis and other techniques to get the probable molecular formulae of bakelite. Double differential scattering cross sections, scattering law values and frequency distributions were determined with 15% error using the neutron inelastic scattering method. The frequency distributions as well as the overall results from all experimental techniques used in this work allowed to suggest a structural model like polycyclic hydrocarbons, for calcined bakelite at 800^0 C. (author).

6053 (INIS-mf–14088) **MOCVD for high temperature supraconductors. Precursors for high temperature supraconductors. Final report.** Doellein, G.; Koehler, K.; Park, J.W.; Jaeger, P. Solvay Deutschland GmbH, Hannover (Germany); Solvay Barium Strontium GmbH, Hannover (Germany); Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Jul 1991 27p. (In German). Contract BMFT 13N5825. Order Number DE93744270. Source: OSTI; NTIS (US Sales Only); INIS.

The target of the research project was to develop a synthesis of barium-, yttrium, calcium- and strontium compounds which are stabilised in terms of their rate of evaporation and are used as precursors for CVD-separation of high temperature supraconductors. Special attention was given to the synthesis of β-di-ketonate barium-bis(2,2,6,6,-tetramethyl-3,5-heptanedionate) [Ba $(TMHD)_2$]. This product is characterised by: 1. constant rate of evaporation, 2. high longterm stability and 3. water content < 0.3%. (MM).

6054 (IS-T–1597) **Sputter-deposition and characterization of molybdenum disulfide thin films.** Obeng, J. Ames Lab., IA (United States). 9 Sep 1992. 166p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-82. Order Number DE93004801. Source: OSTI; NTIS; GPO Dep.

MoS_x films were deposited on Si substrates by rf planar magnetron sputtering of hot-pressed MoS_2 in Ar or H_2S/Ar and of Mo in H_2S/Ar. Results indicated that MoS_x film properties can be controlled more easily by sputtering Mo in H_2S/Ar. The surface-sensitive technique of IRRAS (infrared reflection-absorption spectroscopy) was used to study CO adsorption on MoS_x thin films sputter-deposited on Si, Au/Si and Pt/Si substrates. The spectra suggested mainly gas phase CO with multiple absorption bands about the 2162 and 2114 cm^{-1} regions for CO pressures over 30 torr; no CO bands were observed for monolayer coverages.

Progress was made in sputter-depositing MoS_x/metal/Si thin films with preferred orientation.

6055 (KFK–5089) **A method of determination of the regular stress term for an arbitrary joint geometry under thermal loading.** Yang, Y.Y.; Munz, D. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Materialforschung. Sep 1992. 29p. Order Number DE93744816. Source: OSTI; NTIS (US Sales Only); INIS.

The problem is treated of a two dissimilar materials joint with arbitrary edge angles under thermal loading. Emphasis is placed on the investigation of the regular stress term, which is independent of the distance r, in the stress field near the singular point. A method of calculating the regular stress term $\sigma_{\gamma\theta}(\theta)$ analytically for arbitrary angles θ_1 and θ_2 is presented. Numerical results of $\sigma_{\gamma\theta}$ for special wedges are included for all possible Dundurs parameters. It is shown that under thermal loading conditions the regular stress term is very important to the stress distribution on the near field of the singularity point. (orig.).

6056 (LA-UR–92-3238) **Doping induced insulator-metal transition in the platinum based MX complexes.** Huang, X.Z.; Saxena, A.; Bishop, A.R. Los Alamos National Lab., NM (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9208132–4: 1992 international conference on science and technology of synthetic metals (ICSM), Goeteborg (Sweden), 12-18 Aug 1992). Order Number DE93003690. Source: OSTI; NTIS; GPO Dep.

Platinum halide linear chain MX (X = Cl, Br, I) complexes exhibit various strengths of the charge-density-wave (CDW) ground state. One way of characterizing the strength is to study the response to charge doping. On a finite length chain, we found that PtCl preserves its CDW pattern while forming a polaron array when doped; PtI is rapidly unstable against charge doping and undergoes an insulator-metal transition easily; PtBr is in between PtCl and PtI. These trends are consistent with the CDW strength, which is strong for PtCl, medium for PtBr and very weak for PtI.

6057 (LA-UR–92-3596) **Strain measurement in individual phases of an Al/TiC composite during mechanical loading.** Bourke, M.A.M. (Los Alamos National Lab., NM (United States)); Goldstone, J.A.; Stout, M.G.; Lawson, A.C.; Allison, J.E. Los Alamos National Lab., NM (United States). [1992]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930202–2: Annual meeting of The Metallurgical Society, Denver, CO (United States), 21-25 Feb 1993). Order Number DE93003806. Source: OSTI; NTIS; GPO Dep.

Neutron diffraction provides a unique method for examining materials during thermo-mechanical loading because it is nondestructive and penetrating and can distinguish between the strains in individual phases. Using a pulsed neutron source, all lattice reflections are recorded in all constituents simultaneously. Preliminary in-situ strain measurements under- load of an aluminum/titanium carbide composite are presented here. The measurements were made using a compact stress rig on the neutron powder diffractometer at the Manuel Lujan Jr. Neutron Scattering Center at Los Alamos National Laboratory.

6058 (LA-UR–92-3755) **Conducting polymers as potential active materials in electrochemical supercapacitors.** Rudge, A. (Los Alamos National Lab., NM (United States)); Davey, J.; Raistrick, I.; Gottesfeld, S.; Ferraris, J.P. Los Alamos National Lab., NM (United States). [1992]. 32p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-921232–1: 2. international seminar on double layer-capacitors and similar energy storage devices, Deerfield, FL (United States), 7-9 Dec 1992). Order Number DE93003827. Source: OSTI; NTIS; GPO Dep.

Electronically,conducting polymers represent an interesting class of materials for use in electrochemical capacitors because of the combination of high capacitive energy density and low materials cost. Three generalized types of electrochemical capacitors can be constructed using conducting polymers as active material, and in the third of these, which utilizes conducting polymers that can be both n- and p-doped, energy densities of up to 40 watt-hours per kilogram of active material on both electrodes have been demonstrated.

6059 (LA-UR–92-3831) **Diffraction measurements of residual stress in titanium matrix composites.** James, M.R. (Rockwell International Science Center, Thousand Oaks, CA (United States)); Bourke, M.A.; Goldstone, J.A.; Lawson, A.C. Los Alamos National Lab., NM (United States); Rockwell International Corp., Thousand Oaks, CA (United States). Science Center. [1992]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930202–3: Annual meeting of The Metallurgical Society, Denver, CO (United States), 21-25 Feb 1993). Order Number DE93003855. Source: OSTI; NTIS; GPO Dep.

Metal matrix composites develop residual strains after consolidation due to the thermal expansion mismatch between the reinforcement fiber and the matrix. X-ray and neutron diffraction measured values for the longitudinal residual stress in the matrix of four titanium MMCs are reported. For thick composites (> 6 plies) the surface stress measured by x-ray diffraction matches that determined by neutron diffraction and therefore represents the stress in the bulk region consisting of the fibers and matrix. For thin sheet composites, the surface values are lower than that in the interior and increase as the outer rows of fibers are approached. While a rationale for the behavior in the thin sheet has yet to be developed, accounting for composite thickness is important when using x-ray measured values to validate analytic and finite element calculations of the residual stress state.

6060 (LA-UR–92-3917) **Numerical validation of a constitutive theory for an arbitrarily fractured solid.** Trent, B.C.; Margolin, L.G. Los Alamos National Lab., NM (United States). [1992]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930365–2: International conference on discrete element methods, Cambridge, MA (United States), 17-18 Mar 1993). Order Number DE93003863. Source: OSTI; NTIS; GPO Dep.

We have developed a general constitutive theory that estimates the effective elastic moduli of a cemented granular material by applying statistical mechanical averaging to a purely micromechanical model. We have also constructed a distinct element model of a cemented granular material, based on the same micromechanical model, which accounts for the elastic forces due to bonding between pairs of spherical particles, and which allows for the possibility of anisotropic damage to the bonds. In this paper, we use a model based on the distinct element method (DEM) to validate the predictions of damage. In predictions of the theory for various prescribed patterns of damage. In particular we impose several anisotropic patterns of damage on the bonds of a randomly generated assembly of particles. We then do numerical experiments, sending both p-waves and s-waves through the samples and measuring the wave velocities. The predictions of the theory for these velocities agree well with the results of the numerical model for a variety of damage patterns. We discuss the implications of our theory as well as potential applications.

6061 (LBL–32833) **Electron correlations in semiconductors: Bulk cohesive properties and magnetic-field-induced Wigner crystal at heterojunctions.** Louie, S.G.; Zhu, X. Lawrence Berkeley Lab., CA (United States). Aug 1992. 8p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract AC03-76SF00098. Grant FD91-20269. (CONF-920825–2: 21. international conference on the physics of semiconductors, Beijing (China), 10-14 Aug 1992). Order Number DE93002626. Source: OSTI; NTIS; GPO Dep.

A correlated wavefunction variational quantum Monte Carlo approach to the studies of electron exchange and correlation effects in semiconductors is presented. Applications discussed include the cohesive and structural properties of bulk semiconductors, and the magnetic-field-induced Wigner electron crystal in two dimensions. Landau level mixing is shown to be important in determining the transition between the quantum Hall liquid and the Wigner crystal states in the regime of relevant experimental parameters.

6062 (LBL–33020) **Metallization and insulization during impact.** Gilman, J.J. Lawrence Berkeley Lab., CA (United States).

Oct 1992. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-921162–15: Hypervelocity impact symposium, Austin, TX (United States), 17-20 Nov 1992). Order Number DE93004708. Source: OSTI; NTIS; GPO Dep.

It is pointed out that the large strains produced by hypervelocity impacts can be expected to produce dramatic changes in the chemical bonding (electronic structures) of materials. This will change the mechanical behavior towards increased ductility when a semiconductor is compressed until it becomes metallic; and towards increased brittleness when a transition metal is expanded so as to localize its d-band electrons. Both isotropic compression (expansion) and shear strains can cause these transformations. Critical deformation criteria are given based on the observed cubic to tetragonal transformations in compressed semiconductors.

6063 (LUTVDG/TVBM–1011-1-132-1992) **Time-dependent crack growth and fracture in concrete.** Zhou Fan Ping. Lund Univ. (Sweden). Dept of Building Technology. Feb 1992. [141] Order Number DE93609044. Source: OSTI; NTIS; INIS.

The objectives of this thesis are to study time-dependent fracture behaviour in concrete. The thesis consists of an experimental study, costitutive modelling and numerical analysis. The experimental study was undertaken to investigate the influences of time on material properties for the fracture process zone and on crack growth and fracture in plain concrete structures. The experiments include tensile relaxation tests, bending tests on notched beams to determine fracture energy at varying deflection rates, and sustained bending and compact tensile tests. From the tensile relaxation tests, the envelope of the σ-w relation does not seem to be influenced by holding periods, though some local detrimental effect does occur. Fracture energy seems to decrease as rates become slower. In the sustained loading tests, deformation (deflection or CMOD) growth curves display three stages, as usually observed in a creep rupture test. The secondary stage dominates the whole failure lifetime, and the secondary deformation rate appears to have good correlation with the failure lifetime. A crack model for time-dependent fracture is proposed, by applying the idea of the Fictitious Crack Model. In this model, a modified Maxwell model is introduced for the fracture process zone incorporated with the static σ-w curve as a failure criterion, based on the observation of the tensile relaxation tests. The time-dependent σ-w curve is expressed in an incremental law. The proposed model has been implemented in a finite element program and applied to simulating sustained flexural and compact tensile tests. Numerical analysis includes simulations of crack growth, load-CMOD curves, stress-failure lifetime curves, size effects on failure life etc. The numerical results indicate that the model seems to be able to properly predict the main features of time-dependent fracture behaviour in concrete, as compared with the experimental results. 97 refs.

6064 (ORNL/Sub–87-00184/03) **Polyorganosilazane preceramic binder development for reaction bonded silicon nitride composites.** Mohr, D.L. (Georgia Tech Research Inst., Atlanta, GA (United States)); Starr, T.L. Oak Ridge National Lab., TN (United States); Georgia Tech Research Inst., Atlanta, GA (United States). Nov 1992. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93004063. Source: OSTI; NTIS; GPO Dep.

This study has examined the use of two commercially available polyorganosilazanes for application as preceramic binders in a composite composed of silicon carbide fibers in a reaction bonded silicon nitride (RBSN) matrix. Ceramic monolithic and composite samples were produced. Density of monolithic and whisker reinforced RBSN samples containing the polysilazane binder was increased. Mercury intrusion porosimetry revealed a significant decrease in the pore sizes of samples containing a polyorganosilazane binder. Electron micrographs of samples containing the preceramic binder looked similar to control samples containing no precursor. Overall, incorporation of the polysilazane into monolithic and whisker reinforced samples resulted in significantly increased density and decreased porosity. Nitriding of the RBSN was slightly retarded by addition of the polysilazane binder. Samples with the preceramic binders contained increased contents of α versus β-silicon nitride which may be due to interaction of hydrogen evolved from polysilazane pyrolysis with the nitriding process. Initial efforts to produce continuous fiber reinforced composites via this method have not realized the same improvements in density and porosity which have been observed for monolithic and whisker reinforced samples. Further, the addition of perceramic binder resulted in a more brittle fracture morphology as compared to similar composites made without the binder.

6065 (SAND–91-2891C) **Imogolite as a material for fabrication of inorganic membranes.** Huling, J.C. (New Mexico Univ., Albuquerque, NM (United States). Center for Micro-Engineered Ceramics); Smith, D.M.; Bailey, J.K.; Brinker, C.J. Sandia National Labs., Albuquerque, NM (United States). [1991]. 7p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract AC04-76DP00789. Grant CDR-8803512. (CONF-920402–63: 1992 Material Research Society (MRS) spring meeting, San Francisco, CA (United States), 27 Apr - 2 may 1992). Order Number DE93002306. Source: OSTI; NTIS; GPO Dep.

Imogolite is a structurally microporous tubular clay comprising one-dimensional pore channels that are 0.8–1.2 nm in diameter, depending on composition. The microporous structure of natural and synthetic imogolite has been investigated by nitrogen adsorption as a function of outgassing temperature. A significant increase in adsorption at low relative pressure ($P/P_o \sim 10^{-6}$) after 275°C outgassing reflects a high concentration and narrow distribution of 0.8–0.9 nm diameter pores (i.e., the imogolite tubes) and supports the potential use of imogolite in inorganic membrane applications.

6066 (SAND–91-2892C) **Sol-gel films with tailored microstructures.** Logan, D.L. (Sandia National Labs., Albuquerque, NM (United States)); Ashley, C.S.; Brinker, C.J. Sandia National Labs., Albuquerque, NM (United States). [1991]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-920402–64: 1992 Material Research Society (MRS) spring meeting, San Francisco, CA (United States), 27 Apr - 2 may 1992). Order Number DE93003247. Source: OSTI; NTIS; GPO Dep.

The refractive index and porosity of silicate films formed by dip-coating were tailored by varying the aging time of a two-step acid- and base-catalyzed sol to control the size and structure of the polymeric species prior to coating. ^{29}Si NMR showed that there was a 2% increase in the total number of bridging oxygens with sol age, consistent with a cluster-cluster growth mechanism. However, several percent monomer remained regardless of aging. Dip-coated films were characterized by ellipsometry before and after heating to moderate temperatures at three rates. Sol aging prior to film deposition leads to greater film porosity, consistent with the concept of aggregation of fractal clusters, but only after a heat treatment to remove the organic species associated with incompletely hydrolyzed monomers from the pores.

6067 (SAND–92-1374) **Shock characterization of Diallyl Phthalate (DAP).** Weirick, L.J. Sandia National Labs., Albuquerque, NM (United States). Sep 1992. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93002595. Source: OSTI; NTIS; GPO Dep.

This study involved the shock characterization of Diallyl Phthalate (DAP), in particular, the equation of state as measured by the shock Hugoniot. Tests were done between 1 and 11 GPa impact shock pressure. The Hugoniot parameters were determined to be: ρ_0= 1.743, C_0 = 2.20, and S = 2.33.

6068 (SAND–92-2177C) **Piezoelectric response of precisely poled PVDF to shock compression greater than 10 GPa.** Bauer, F. (Institut Franco-Allemand de Recherches de Saint-Louis, 68 (France)); Lefebvre, H.; Graham, R.A.; Anderson, M.U.; Reed, R.P.; Lee, L.M. Sandia National Labs., Albuquerque, NM (United States). [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9208183–1: 8. international symposium on applications of ferroelectrics, Spokane, WA (United States), 31 Aug - 2 sep 1992). Order Number DE93002469. Source: OSTI; NTIS; GPO Dep.

Prior work has shown that the piezoelectric response of shock-compressed PVDF film prepared with attention to mechanical and electrical processing exhibits precise, well-defined, reproducible

behavior to 10 GPa. Higher pressure response continues to pressures approaching 50 GPa, and appears to provide a basis for a very high pressure stress-rate gauge. Previous work shows that differences in response were sometimes observed. The present report describes studies in progress undertaken to increase the precision of the polarization of the PVDF and to develop optimum sensors and shock gauge package designs. Results obtained on such careful prepared PVDF shock gauges show that differences in electrical charge response less than few percent are observed between 10 and 25 GPa.

6069 (SAND–92-7005) **Fatigue of fiberglass wind turbine blade materials.** Mandell, J.F. (Montana State Univ., Bozeman, MT (United States). Dept. of Chemical Engineering); Reed, R.M.; Samborsky, D.D. Sandia National Labs., Albuquerque, NM (United States); Montana State Univ., Bozeman, MT (United States). Dept. of Chemical Engineering. Aug 1992. 61p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93005381. Source: OSTI; NTIS; GPO Dep.

Fatigue behavior for a variety of generic materials used in wind turbine blades has been explored. Coupon testing was carried out under constant amplitude tensile fatigue loading to beyond 10^7 cycles for most materials. Unidirectional materials performed close to expectations despite fiber misalignment. Materials with triaxial (0/ ±45) reinforcement showed greater fatigue sensitivity than expected, but lifetime trends flattened at high cycles. The uniaxial and triaxial materials could be normalized to a single S-N lifetime trend for each case. Results include the effects of differing matrix materials, manufacturing methods, reinforcement structure, and ply terminations. Materials were supplied by Phoenix Industries and US Windpower.

6070 (STUVA–27/91) **Experimental investigations of the geomechanical behaviour of plastic sealing sheets for sealing dumps. Final report.** Schreyer, J.; Wiesbaum, E. Studiengesellschaft fuer Unterirdische Verkehrsanlagen e.V. (STUVA), Koeln (Germany); Ingenieurbuero Dr. Ing. F.W. Knipschild, Seevetal (Germany); Ministerium fuer Umwelt, Raumordnung und Landwirtschaft des Landes Nordrhein-Westfalen, Duesseldorf (Germany). Dec 1991. 81p. (In German). Order Number DE93750626. Source: OSTI; NTIS (US Sales Only).

Due to more severe environmental requirements, dumps have to be largely sealed to prevent harmful substances escaping into the environment and according to the state of technology, this is done by the combination of clay and plastic sealing tracks. Building on the knowledge from a completed research project 'On the investigation of possibilities related to applications of a process for testing the mechanical behaviour of dump base seals made from sealing sheets', the test processes described there were developed further and proposals were worked out for standardized execution of experiments. With the aid of a large number of experiments, minimum requirements were determined, which should serve to define the geo-mechanical properties of the plastic sealing sheets and to determine binding limits. (BBR).

6071 (SVF–450) **Development of methods for quality assurance of preinsulated joints.** Cronholm, L.Aa. (Studsvik AB, Nykoeping (Sweden)); Westin, R. Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden); Studsvik AB, Nykoeping (Sweden). Jul 1992. 64p. (In Swedish). (STUDSVIK-UD–91-23). Order Number DE93753062. Source: OSTI; NTIS.

Quality assurance (QA) for a preinsulated joint begins with the planning and request for quotations, and is not complete until the final document concerning the projects is filed. The aim of this project has therefore meant that the entire process, with the emphasis on the control methods, has been evaluated to identify possible improvements for the QA of joining preinsulated pipes. Our results can be summarized as follows: Efforts made at Quality Assurance must exist at all stages and levels of the process. Small improvements in a large number of stages can give a good result compared with a larger effort in a specific stage. The driving force for a well functioning QA is a control function with precisely defined areas of responsibility and authority. Further a well developed internal control system at the contractor's is necessary, which in turn means work sheets and control methods including statements concerning tolerances. The purchaser must ensure that the inspectors check list and the work sheets from the various contractors are included in the quotation. Check lists and work sheets must include parameters which are aimed at establishing good premises for subsequent stages of the work. To the extent that such documents do not exist in a generalized form, project specific documentation must be established. Reports of experience of damage and failure in connection with pipe laying and operation must be felt to be relevant and reliable. The suggestions presented in this report should not lead to any costly sacrifices of magnitude. On the other hand, a consistency is necessary when introducing them to achieve the potential QA improvements. (au) (18 figs.).

6072 (TVA-Bull–Z-317) **Research on the degradation of concrete: A planned approach.** Copeland, C.H.; Harner, A.L.; Crim, B.G.; Broder, M.F. National Fertilizer and Environmental Research Center, Muscle Shoals, AL (United States). [1992]. 50p. Sponsored by Tennessee Valley Authority, Knoxville, TN (United States). (CONF-920815–17: 204. American Chemical Society (ACS) national meeting, Washington, DC (United States), 23-28 Aug 1992). Order Number DE93003907. Source: OSTI; NTIS.

Degradation of concrete from reaction with agrichemicals is a problem which will become more significant as fertilizer dealers are required to increase their use of loading pads and secondary containment structures. National Fertilizer and Environmental Research Center (NFERC) has initiated research to determine degradation mechanisms and develop preventative measures to extend the useful life of concretes which come into contact with agrichemicals. This paper outlines the research program including procedures used to assure the quality of results and presents research results to date.

6073 (TVA-Bull–Z-319) **The effects of exposure of fertilizer solutions on concretes containing additives.** Nguyen, D.T.; Nichols, D.E.; Cole, C.A. National Fertilizer and Environmental Research Center, Muscle Shoals, AL (United States). [1992]. 18p. Sponsored by Tennessee Valley Authority, Knoxville, TN (United States). (CONF-920815–13: 204. American Chemical Society (ACS) national meeting, Washington, DC (United States), 23-28 Aug 1992). Order Number DE93003909. Source: OSTI; NTIS.

Concrete made from Portland cement, with and without additives, was exposed to urea-ammonium nitrate and to ammonium polyphosphate solutions for periods up to one year. The degree of deterioration of the test specimens was evaluated based on visual examination, decrease in compression strength, and depth of penetration of the test solution into the specimen interior. 7 tabs.

6074 (UCRL–53943-91, pp. 4-6) **Organic aerogels: The next generation.** Pekala, R.W.; Alviso, C.T. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

The aqueous sol-gel polymerization of melamine with formaldehyde, followed by supercritical extraction, leads to the formation of a new type of organic aerogel. Low density (0.1 to 0.8 g/cm^3), large surface area (~ 1,000 m^2/g), and optical clarity are only a few of the promising characteristics of melamine-formaldehyde aerogels.

6075 (UCRL–53943-91, pp. 7-8) **High-performance nano-engineered multilayer materials.** Barbee, T.W. Jr. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

The author is designing and producing nanostructure multilayer materials at atomic and near-atomic scales. These nanostructure materials have the potential for extremely high mechanical performance that approaches their theoretical strengths.

6076 (UCRL–53943-91, pp. 62-64) **Synthesis of very high-porosity silica aerogels.** Hrubesh, L.W.; Tillotson, T.M.; Poco, J.F. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

Aerogels are among the lightest of all man-made materials, but until now the ability to make truly high-porosity aerogels has been limited. The authors have successfully formed silica aerogels that are barely as dense as the gas that fills their pores and that have

a different microstructure than conventional, lower-porosity aerogels. They also have unique optical, mechanical, and thermal properties that result directly from the especially large proportion of trapped air in their pores.

6077 (UCRL–53943-91, pp. 65-67) **Elimination of scattering centers from Cr:LiCaAlF$_6$.** Roberts, D.H. (Lawrence Livermore National Lab., CA (United States)); De Yoreo, J.J.; Atherton, L.J. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

The authors have determined the morphology and composition of submicrometer-sized defects in single crystals of the laser host $LiCaAlF_6$ (LiCAF). Annealing within 50 C of the melting point eliminates these defects and reduces passive scattering losses in the crystals by an order of magnitude. During annealing, these defects dissolve into the matrix and then diffuse out of the crystal. The authors hypothesize a mechanism for the growth and elimination of defects in LiCAF.

6078 (UCRL–53943-91, pp. 68-70) **Preparation and properties of brominated plasma polymer coatings.** Letts, S.A.; Price, C.W.; Kong, F.M.; Buckley, S.R.; Saculla, M.D.; Lindsey, E.F.; Moore, C.E.; Welch, P. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

The authors have developed a plasma polymerization process for depositing brominated polymer coatings for laser experiments. They used an X-ray radiographic gauging technique and X-ray microfluorescence to measure composition and used atomic force microscopy to measure the surface finish of the coatings. The authors found that the surface finish improved to better than 50 nm peak-to-valley with increased total gas flow rates.

6079 (UCRL–53943-91, pp. 71-74) **Epoxy adhesive with high fracture toughness.** Lyon, R.E.; LeMay, J.D. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

The authors have developed a structural epoxy adhesive that has a fracture toughness of 1.3 $MPa\sqrt{m}$ and cures completely at 75 C. Originally developed to bond BeO components in an LLNL weapon system, this adhesive has proven effective as a general-purpose structural adhesive for a variety of high-surface-energy substrates, including metals, metal-oxide ceramics, and glasses. The low surface tension of the liquid adhesive, 32 mJ/m^2, promotes wetting of low-surface-energy solids (such as plastics and fiber-reinforced polymer composites) for high bond strength.

6080 (UCRL–53943-91, pp. 155-158) **Tensile failure in metal-matrix composites.** Kinney, J.H. (Lawrence Livermore National Lab., CA (United States)); Sattler, M.L.; Zywicz, E.; Saroyan, R.A.; Nichols, M.C. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

The authors have shown that, because of the heterogeneous, two-phase microstructure of composites, failure may have a dual origin: properties of the fiber-matrix interface and defects that originate in the interior of the fiber. Although core and interior failure have been observed in single-fiber tensile tests, these are the first observations that indicate the possibility of significant failure near the fiber interior in a fabricated composite.

6081 (UCRL-JC–112024) **Role of porosity in estimates of composite elastic constants.** Berryman, J.G. Lawrence Livermore National Lab., CA (United States). Oct 1992. 29p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-930154–1: Symposium on composite material technology, Houston, TX (United States), 31 Jan - 3 feb 1993). Order Number DE93002887. Source: OSTI; NTIS; GPO Dep.

The presence of small amounts of residual void space (on the order of one percent by volume) is sufficient to make estimates of composite elastic constants (obtained while ignoring this porosity) violate the Hashin-Shtrikman bounds in many cases. Experimental values falling below the incorrectly estimated lower bound is the normal direction of violation, but erroneous neglect of porosity in "pure" samples can also lead to experimental values rising above the incorrectly computed upper bound. Examples are presented to illustrate the nature of the error and methods of correcting it for data on composite ceramics. The result is improved agreement between the Hashin-Shtrikman bounds, effective medium theory estimates, and experimental data.

6082 (UCRL-JC–112124) **Barium fluoride surface preparation, analysis and UV reflective coatings at Lawrence Livermore National Laboratory.** Wuest, C.R. Lawrence Livermore National Lab., CA (United States). 27 Oct 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9209253–1: Crystal 2000 international workshop on heavy scintillators for scientific and industrial applications, Chamonix (France), 22-26 Sep 1992). Order Number DE93003136. Source: OSTI; NTIS; INIS; GPO Dep.

Lawrence Livermore National Laboratory (LLNL) has begun a program of study on barium fluoride scintillating crystals for the Barium Fluoride Electromagnetic Calorimeter Collaboration. This program has resulted in a number of significant improvements in the mechanical processing, polishing and coating of barium fluoride crystals. Techniques have been developed using diamond-loaded pitch lapping that can produce 15 angstrom RMS surface finishes over large areas. These lapped surfaces have been shown to be crystalline using Rutherford Back-scattering (RBS). Also, special polishing fixtures have been designed based on mounting technology developed for the 1.1 m diameter optics used in LLNL's Nova Laser. These fixtures allow as many as five 25–50 cm long barium fluoride crystals to be polished and lapped at a time with the necessary tolerances for the 16,000 crystal Barium Fluoride Calorimeter. In addition, results will be presented on coating barium fluoride with UV reflective layers of magnesium fluoride and aluminum.

6083 (UM-P–92/06) **Thermodynamic analysis of processes proceeding on (111) faces of diamond during chemical vapour deposition.** Piekarczyk, W.; Prawer, S. Melbourne Univ., Parkville, VIC (Australia). School of Physics. [1992]. [17] Sponsored by Office of Naval Research, Washington, DC (United States). Contract N00014-86-K0443. Order Number DE93609039. Source: OSTI; NTIS (US Sales Only); INIS.

Chemically vapour deposited diamond is commonly synthesized from activated hydrogen-rich, carbon/hydrogen gas mixtures under conditions which should, from a thermodynamic equilibrium point of view, favour the production of graphite. Much remains to be understood about why diamond, and not graphite, forms under these conditions. However, it is well known that the presence of atomic hydrogen, is crucial to the success of diamond deposition. As part of an attempt to better understand the deposition process, a thermodynamic analysis of the process was performed on diamond (111) faces in hydrogen rich environments. It is shown that the key role of atomic hydrogen is to inhibit the reconstruction of the (111) face to an sp^2-bonded structure, which would provide a template for graphite, rather than diamond formation. The model correctly predicts experimentally determined trends in growth rate and diamond film quality as a function of methane concentration in the stating gas mixture. 17 refs., 4 figs.

6084 (UM-P–92/30) **Investigation of carbon near the graphite-diamond-liquid triple point.** Prawer, S. (Melbourne Univ., Parkville (Australia). School of Physics); Jamieson, D.N.; Kalish, R. Melbourne Univ., Parkville, VIC (Australia). School of Physics. [1992]. [14] Sponsored by Australian Research Council, Canberra, ACT (Australia); Department of Industry, Technology and Commerce, Canberra, ACT (Australia). Order Number DE93609052. Source: OSTI; NTIS (US Sales Only); INIS.

Pulsed laser irradiation is used to heat deeply buried damage layers in diamond. Over a small range of laser powers, damage annealing, formation of buried graphitic layers, and melting of diamond followed by its conversion upon cooling into graphite are observed. The diagnostics employed are Channeling Contrast Microscopy, optical absorption, surface profilometry, and scanning and optical microscopies. The results are explained in terms of the behaviour of carbon under high internal pressures close to the

diamond-graphite-liquid carbon triple point in the phase diagram. 17 refs., 3 figs.

6085 (UM-P–92/33) **HREM study of crystallography of titanium and titanium hydride thin films.** Kasukabe, Y. (Tohoku Univ., Sendai (Japan). Dept. of Physics); Yamada, Y.; Bursill, L.A. Melbourne Univ., Parkville, VIC (Australia). School of Physics. [1992]. [6] Sponsored by Australian Research Council, Canberra, ACT (Australia). Order Number DE93609038. Source: OSTI; NTIS (US Sales Only); INIS.

The purpose of this work is to first examine the microscopic structure of evaporated Ti films on NaCl substrates using high-resolution TEM observations and then to discuss the crystallographic relationships and growth mechanism of the films. 6 refs., 4 figs.

6086 (Y/EN–4764) **Testing of clay tile infilled frames.** Flanagan, R.D. (Oak Ridge Y-12 Plant, TN (United States)); Bennett, R.M.; Burdette, E.G.; Goodpasture, D.W. Oak Ridge Y-12 Plant, TN (United States). 21 Aug 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OS21400. (CONF-9209258–2: Unreinforced hollow clay tile workshop, San Francisco, CA (United States), 21-22 Sep 1992). Order Number DE93002703. Source: OSTI; NTIS; GPO Dep.

Several large-scale static tests of clay tile infilled frames were recently conducted. For in-plane racking tests, the effects of cyclic loading, varying frame stiffness, varying infill size, infill offset from frame centerline, and single and double wythe infill construction were investigated. Out-of-plane tests examined infilled frame response to inertial loadings and inter-story drift loadings. Multiple loadings were performed to determine in-plane strength and stiffness degradation from both out-of-plane loadings. To determine constitutive properties of the infills, prism compression, mortar compression and various unit tile tests were performed.

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Refer also to citation(s) 6787

6087 (DOE/EM–0089T) **DOE methods for evaluating environmental and waste management samples.** Goheen, S.C.; McCulloch, M.; Thomas, B.L.; Riley, R.G.; Sklarew, D.S.; Mong, G.M.; Fadeff, S.K. (eds.). USDOE Assistant Secretary for Environmental Restoration and Waste Management, Washington, DC (United States). Oct 1992. 119p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93004627. Source: OSTI; NTIS; INIS; GPO Dep.

This publication provides applicable methods in use by the US Department of Energy (DOE) laboratories for the analysis of constituents of waste and environmental samples. This document contains chapters and methods that are proposed for use in evaluating components of DOE environmental and waste management samples. It is a resource intended to support sampling and analytical activities that will determine whether environmental restoration or waste management actions are needed, as defined by the DOE, the US Environmental Protection Agency (EPA), or others.

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Refer also to citation(s) 4845, 4865, 4869, 4892, 4946, 5047, 5048, 5049, 5051, 5053, 5056, 5060, 5094, 5136, 5142, 5204, 5516, 5517, 5886, 5910, 5994, 6052, 6065, 6084, 6085, 6158, 6166, 6171, 6551, 6575, 6594, 6609, 6617, 6654, 6713, 6832, 6836, 6844, 7075, 7294, 7296, 7297

6088 (ANL/ACL–92/3) **The stability of calibration standards for ICP/AES analysis: Six-month study.** Huff, E.A.; Huff, D.R. Argonne National Lab., IL (United States). Analytical Chemistry Lab. May 1992. 53p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93003217. Source: OSTI; NTIS; GPO Dep.

The stability of instrument calibration standards for Inductively Coupled Plasma/Atomic Emission Spectrometric (ICP/AES) analysis was studied over a six-month period. Data were obtained as functions of analyte concentration, acid type, and acidity. The impact of acid concentration on signal-to-background ratios (S/B) was also assessed. The results show that analytes maintain their integrity over extended periods with appropriate inorganic acid preservatives. Thus, frequent standard preparations become unnecessary to obtain valid analytical data.

6089 (ANL/CHM/CP–73956) **Ion beam-based characterization of multicomponent oxide thin films and thin film layered structures.** Krauss, A.R. (Argonne National Lab., IL (United States)); Rangaswamy, M.; Lin, Yuping; Gruen, D.M.; Schultz, J.A.; Schmidt, H.K.; Chang, R.P.H. Argonne National Lab., IL (United States). [1992]. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9209264–1: NATO Advanced Study Institute on multicomponent and multilayered thin films for advanced microtechnologies, techniques, fundamentals and devices, Bad Windsheim (Germany), 22 Sep - 6 oct 1992). Order Number DE93003004. Source: OSTI; NTIS; INIS; GPO Dep.

Fabrication of thin film layered structures of multi-component materials such as high temperature superconductors, ferroelectric and electro-optic materials, and alloy semiconductors, and the development of hybrid materials requires understanding of film growth and interface properties. For High Temperature Superconductors, the superconducting coherence length is extremely short (5–15 Å), and fabrication of reliable devices will require control of film properties at extremely sharp interfaces; it will be necessary to verify the integrity of thin layers and layered structure devices over thicknesses comparable to the atomic layer spacing. Analytical techniques which probe the first 1–2 atomic layers are therefore necessary for in-situ characterization of relevant thin film growth processes. However, most surface-analytical techniques are sensitive to a region within 10–40 Å of the surface and are physically incompatible with thin film deposition and are typically restricted to ultra high vacuum conditions. A review of ion beam-based analytical methods for the characterization of thin film and multi-layered thin film structures incorporating layers of multicomponent oxides is presented. Particular attention will be paid to the use of time-of-flight techniques based on the use of 1- 15 key ion beams which show potential for use as nondestructive, real-time, in-situ surface diagnostics for the growth of multicomponent metal and metal oxide thin films.

6090 (ANL/MSD/CP–77607) **Synchrotron and laboratory studies utilizing a new powder diffraction technique.** Knapp, G.S.; Beno, M.A.; Jennings, G.; Engbretson, M.; Ramanathan, M. Argonne National Lab., IL (United States). Oct 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9208129–5: Annual Denver x-ray conference, Denver, CO (United States), 3-7 Aug 1992). Order Number DE93002981. Source: OSTI; NTIS; GPO Dep.

We have developed a new type of powder diffractometer that is much more efficient than existing methods. The diffractometer has the potential of both high count rates and very high resolution when used at a synchrotron source. The laboratory based instrument has an order of magnitude improvement in count rate over existing methods. The method uses a focusing diffracted beam monochromator in combination with a multichannel detector. The incident x-rays fall on a flat plate or capillary sample and are intercepted by a bent focusing monochromator which has the focus of the bend at the sample surface. The powder diffraction lines emerging from the bent crystal monochromator are detected by a linear or 2-dimensional detector. This allows us to eliminate the background from fluorescence or other scattering and to take data over a range of 3° to 4° instead of one angle at a time thereby providing a large improvement over conventional diffractometers. Results are presented for fluorapatite Fe_2O_3, and a high-TC superconductor.

6091 (CDTN-DETQ–010/88) **Separation and purification of gadolinium and others rare earths, and yttrium.** Awwal, M.A.; Filgueiras, S.A.C. Centro de Desenvolvimento da Tecnologia Nuclear (CDTN), Belo Horizonte, MG (Brazil). 1988. [56] (In Portuguese). Order Number DE93608790. Source: OSTI; NTIS (US Sales Only); INIS.

The experimental works in laboratories for developing a solvent extraction process with the purpose of gadolinium separation and purification, and secondarily samarium, europium, lanthanum and

yttrium are described. Using as solvent di-2-ethylhexylphosphoric acid (DEHPA) a preliminary flow chart for separation for these elements are developed. (author).

6092 (DOE/ER/13507–8) **Synthesis and analysis of novel polymers with high permselectivity and permeability in gas separation applications: Progress report, December 1991–December 1992.** Koros, W.J.; Paul, D.R. Texas Univ., Austin, TX (United States). Dept. of Chemical Engineering. 31 Dec 1991. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-86ER13507. Order Number DE93005883. Source: OSTI; NTIS; GPO Dep.

Significant progress was made toward developing advanced materials for gas separation membrane applications and rationalizing molecular structure and efficacy: Synthesized and tested polyarylates based on terephthalic or isophthalic acid or a tertiary butyl derivative of the isophthalic acid with different diols to illustrate the effects of: "opening" the matrix by incorporation of bulky packing inhibiting groups such as the tertiary butyl moiety inhibition of backbone motion via meta connected backbone connections and "tightening" of the matrix by incorporation of polar halogens. Completed high temperature characterization of sorption and transport properties for novel materials. Continued studies of the phenyl-substituted polymers aimed at producing super stable high temperature useful polymers for gas separations. Synthesized a polyarylate based on the spirobiindane diol and bibenzoyl acid chloride to incorporate long flat packable bibenzoyl units between packing disruptive spirobiindane units in an attempt to control the segmental level morphology to produce highly selective "bottleneck" regions between highly open regions.

6093 (DOE/ER/61204–2) **Characterization of gas-aerosol interaction kinetics using morphology dependent stimulated Raman scattering: Final technical report.** Aker, P.M. Pittsburgh Univ., PA (United States). Dept. of Chemistry. [1992]. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER61204. Order Number DE93006084. Source: OSTI; NTIS; GPO Dep.

A research program on the influence of aerosol surface structure on the kinetics of gas-aerosol interactions is proposed. The experiments involve measuring changes in gas phase chemical reaction rates as a function of exposure to a specific aerosol. Aerosols with differing surface properties will be generated by changing the composition and/or temperature of the material making up the aerosol. Kinetic data generated can be used directly in atmospheric modelling calculations. The surface structure of the aerosol will be measured, both before and after reaction, using morphology-dependent enhancement of simulated Raman scattering (MDSRS). Information about the detailed dynamics of gas-aerosol interactions can be obtained by correlating the change in the reaction rate with change in surface structure and by monitoring the change in aerosol surface structure during the course of the reaction. Studies will focus on the condensation and oxidation of sulfur species (sulfur dioxide and dimethyl sulfide) on water aerosols.

6094 (DOE/ER/75585–2) **[Infrared tunable difference frequency laser source]: Final technical report, September 15, 1990–September 14, 1992.** Curl, R.F. Rice Univ., Houston, TX (United States). [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-90ER75585. Order Number DE93005128. Source: OSTI; NTIS; GPO Dep.

Purpose of grant was to purchase equipment necessary to construct an infrared laser source based on difference frequency generation in $AgGaS_2$. This continuous wave, single frequency, tunable infrared source has been assembled and is being used for infrared kinetic spectroscopy of small free radicals important in combustion. Infrared spectra are given for the Q-branch of a combination band (11^11) of N_2O, and for the transient in CO produced by flash photolysis of acetone in various vibrational states.

6095 (DOE/MC/23120–93/C0132) **Ion-exchange membranes for bulk separation of acid gases.** Giarratano, P.; Pellegrino, J.J. National Inst. of Standards and Technology, Boulder, CO (United States). Thermophysics Div. [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI21-86MC23120. (CONF-920951–49: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93003483. Source: OSTI; NTIS; GPO Dep.

The field test has continued with PFSA composite membranes. The substrates have been a microporous polypropylene supplied by 3M Co. The membranes have been imbibed with either aqueous solutions of methyldiethanolamine (MDEA) or n-methylpyrrolidone (NMP). Data from five composite membranes have thusfar been obtained and are presented in the following Figure 6. The composite 1 membrane gave erratic performance before it mechanically failed, but most of the observed separation factors were high enough (>35) to be consistent with the initial results from the gel-NE 111 membrane. The separation factor for the other four composites have been consistently low (between 13 and 3). The main difference is that between composite I and the rest we installed an inertial separator to remove excess moisture from the feed stream. This separator may be too efficient and the membranes may be drying out. Another possibility is that the membranes may just not be made well enough and sufficient uncoated pores may exist to subvert the separation efficiency. We tested a membrane which had been removed from the field test rig in our laboratory permeation equipment. Those results are presented in Figures 7 and 8. Again good agreement between the field test and our lab experiments.

6096 (DOE/MC/26373–93/C0104) **Development of ceramic membrane reactors for high temperature gas cleanup.** Roberts, D.L.; Way, J.D. SRI International, Menlo Park, CA (United States). [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-89MC26373. (CONF-920951–57: US Department of Energy contractors review meeting on gasification and gas stream cleanup systems, Morgantown, WV (United States), 15-17 Sep 1992). Order Number DE93002824. Source: OSTI; NTIS; GPO Dep.

The more difficult part of developing a membrane reactor was making a membrane with suitable permselectivity. Since both the ammonia and H_2S decomposition reactions produce H_2, we want a membrane that selectively permeates hydrogen. We have taken the approach of coating a substrate that has fine pores (a microfilter or ultrafilter) with a completely dense layer and then (except for palladium coatings) malting super fine pores in the dense layer by leaching or pyrolysis. We used four different substrates (Norton 0.2 alumina monolith, Refractron alumina microfilters, Vycor glass, Alcoa ultrafilter) and five different coating materials (Poly N-methyl silazane, Aremco 617 alumina-based glaze, Polycyclohydridomethyl silazane, Aluminum phosphorus oxides, palladium). Only the palladium films on an alumina ultrafilter could be made regularly with a negligible defect population. The other approaches were plagued with cracks and poor reproducibility. We made palladium films on a tubular alumina ultrafilter (US Filter, Warrendale, PA) by electroless plating from a platinum amine complex solution in hydrazine (Rhoda, 1959). The best results were achieved with an ultrafilter pore size of 100 angstroms and with pretreatment of the surface in a stannic/stannous chloride solution. The films were about 5 microns thick and appeared defect free under electron microscopy. Because defect-free palladium films are infinitely selective to hydrogen with respect to the other components of gasifier product gas, we expect that the selectivity of our palladium films will exceed 1000 even with the inevitable defects that accompany real membranes. We have analyzed the performance and economics of membrane reactors for H_2S and NH_3 decomposition using the reaction rates determined experimentally in our catalyst development work and using the permeation behavior of palladium films reported in the literature.

6097 (FEMP/SUB–054) **Proposed lower limits of detection (LLD), decision limits (LC) and error terms for identified analytes from the inorganic, isotopic, bioassay and organic groups.** Jobe, J.M. (Westinghouse Environmental Management Co. of Ohio, Cincinnati, OH (United States). Fernald Environmental Management Project). Westinghouse Environmental Management Co. of Ohio, Cincinnati, OH (United States). Fernald Environmental Management Project; USDOE Fernald Field Office, OH (United States). Jul 1992. 52p. Sponsored by USDOE, Washington, DC

(United States). DOE Contract AC05-86OR21600. Order Number DE93002942. Source: OSTI; NTIS; GPO Dep.

Expressions are presented for these terms for pollutants in environmental samples, using Currie's definitions as a basis. The isotopic section covers alpha and gamma spectroscopy, alpha-beta proportional counting, mass spectrometry, x fluorescence (U, Th). The inorganic section covers trace metals, grease/oil, flash point, U-BrPADAP, Th, NO3-N, NH3-H, F, total suspended solids, U-volumetric, free liquids, % moisture or solid. The bioassay section covers fluorometric fusion, laser phosphorescence, total particulate, gross alpha/beta, Ra226/Ra228, asbestos fiber and bulk. The organic section covers only herbicides at this time.

6098 (HW–30589-Pt.1) **Reactor Section standard analytical methods: Part 1.** Sowden, D. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. Jul 1954. 203p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93002579. Source: OSTI; NTIS (US Sales Only); GPO Dep.

the Standard Analytical Methods manual was prepared for the purpose of consolidating and standardizing all current analytical methods and procedures used in the Reactor Section for routine chemical analyses. All procedures are established in accordance with accepted practice and the general analytical methods specified by the Engineering Department. These procedures are specifically adapted to the requirements of the water treatment process and related operations. The methods included in this manual are organized alphabetically within the following five sections which correspond to the various phases of the analytical control program in which these analyses are to be used: water analyses, essential material analyses, cotton plug analyses boiler water analyses, and miscellaneous control analyses.

6099 (IAEA-AL–056) **Report of the second research co-ordination meeting on the co-ordinated research programme: rapid instrumental and separation methods for monitoring radionuclides in food and environmental samples.** International Atomic Energy Agency, Seibersdorf (Austria). Chemistry Unit. Oct 1992. [38] (CONF-9108228–: 2. research co-ordination meeting on co-ordinated research programme: Rapid instrumental and separation methods for monitoring radionuclides in food and environmental samples, Vienna (Austria), 12-16 Aug 1991). Order Number DE93608744. Source: OSTI; NTIS (US Sales Only); INIS.

The purpose of this Second Research Co-ordinated Meeting (12-16 August 1991) on Rapid Instrumental and Separation Methods for Monitoring Radionuclides in Food and Environmental Samples is to discuss the progress of the programmes since the First Research Co-ordination Meeting, discuss how to validate the methodologies developed (e.g. reference samples, intercomparisons), and outline a schedule for CRP completion by the end of 1992. Radioactive contamination of the environment after a nuclear accident, such as had occurred at Chernobyl, is of serious concern to government officials and members of the general public. In 1990/1991 the Agency was asked to organize the International Chernobyl Project to assess the situation in the USSR. A network of laboratories was organized to carry out the environmental assessment needed for this project. The following recommendations are based on the experience gained by many of the laboratories involved in this project. 1. Maintain a network of analytical laboratories with special skills and experience to provide assessments of radionuclide contamination in the environment in case of a radiological emergency. 2. Methodologies for assessment of contamination in the environment should take into consideration potential trajectories, radioecology, and food chain parameters. 3. Focus on areas of representative sample collection, is situ instrumental and chemical analysis, as well as advanced streamlined laboratory analyses which will facilitate the timeline of an assessment. 4. Conduct intercomparison and testing of technologies, employing standard reference materials and procedures, and field measurements at significantly contaminated area. 5. Conduct training of Member State laboratory personnel through fellowships, special courses, and workshops. 5 refs.

6100 (IAEA-AL–059) **The MacDonald and savage titrimetric procedure for plutonium scaled-down to the milligram level: Automated procedure for routine analysis of safeguards samples containing 2 to 5 mg plutonium.** Ronesch, K. (International Atomic Energy Agency, Seibersdorf (Austria). Safeguards Analytical Lab.); Jammet, G.; Berger, J.; Doubek, N.; Bagliano, G.; Deron, S.; Kuvik, V. International Atomic Energy Agency, Seibersdorf (Austria). Safeguards Analytical Lab. Aug 1992. [29] Order Number DE93608774. Source: OSTI; NTIS (US Sales Only); INIS.

A selective titrimetric procedure directly applicable to both input and product solutions from fast reactor fuel reprocessing was set up by MacDonald and Savage and scaled down to 3 mg of plutonium in sample aliquots at the request of the Safeguards Analytical Laboratory (SAL) of the International Atomic Energy Agency (IAEA), which needed to replace its silver (II) oxide titration procedure by a more selective electrochemical method. Although the procedure is very selective the following species still interfere: Vanadates (almost quantitatively), Neptunium (one electron exchange per mole); Nitrites, Fluorosilicates and Iodates present in mg amount yield slight biases. This paper describes the fully automatized procedure presently applied in SAL for the routine determination of 2 to 5 mg plutonium dissolved in nitric acid solution. The method allows the unattended analysis of 20 aliquots within a five hour period. The equipment including the reagent distribution system, the sample changer and the control units are introduced and the principle design of the software is shortly described. Safety requirements have been addressed and are also reviewed in the report. Results obtained on standard reference materials, international intercomparison samples and actual safeguards samples routinely analyzed with the proposed procedure are presented and compared with results achieved with the semiautomatic mode to demonstrate the performance. International requirements to reduce the amount of radioactive materials in waste will certainly lead to a further reduction of the amount of plutonium in one aliquot. Some future perspective to titrate 1 mg samples are presented in the discussion. 12 refs, 10 figs, 8 tabs.

6101 (INIS-BR–3069) **Aluminium and copper analysis in metallic alloys by neutron activation analysis from an ^{241}Am-Be source.** Carvalho, J. de. Pernambuco Univ., Recife, PE (Brazil). Dept. de Energia Nuclear. 1980[56] (In Portuguese). Order Number DE93608751. Source: OSTI; NTIS (US Sales Only); INIS.

Aluminium and copper have been determined in aluminium alloys by the method of activation with neutrons from an $_{241}$ Am-Be source of intensity 9,8 x 10^6 n/s. The activity induced due to reactions ^{27} Al (n, γ)^{28} Al and ^{63} Cu (n, γ)^{64} Cu have been measured with a NaI (Tl) detector coupled to a single channel system. In order to obtain the samples and standards of about the same composition, the material to be irradiated was powdered. In view of low intensity of neutron source it was necessary to use samples of up to 50 g. A series of preliminary irradiations were carried out to ensure that the geometry for the irradiation and for the counting are reproducible. The results have been compared with those obtained by chemical methods. Assuming that the results obtained by chemical method is exact, a maximum relative error of 3,6% is obtained by this method. The method has a good reproducibility. The time needed for analysis of aluminium and copper are 18 min and 2 hours 40 minutes respectively. Four different samples were analysed. The average of five measurements for one of the samples was: 88.0% for aluminium and 10.0% for copper. The standard deviation and coefficient of variation were 0,8 and 1.0% for aluminium and 0,2 and 2.0% for copper. (author).

6102 (INIS-BR–3076) **^{232}Th - ^{233}Pa separation by extraction chromatography.** Matsuda, H.T.; Araujo, B.F. de. Instituto de Pesquisas Energeticas e Nucleares (IPEN), Sao Paulo, SP (Brazil). 1991[10] (CONF-9110453–: 31. Brazilian Congress on Chemistry, Recife (Brazil), 21-25 Oct 1991). Order Number DE93608791. Source: OSTI; NTIS (US Sales Only); INIS.

Thorium and protactinium behavior in extraction chromatography systems is presented, aiming its separation by selective retention of the micro constituent on the column. TBP/alumina, TBP/voltalef UF 300, TOA/alumina and TOA/voltalef UF 300 systems were verified. Column preparation as well the ^{233} Pa removal conditions were settled. The best ^{232} Th separation from its irradiation product, ^{233} Pa, has been achieved by using TBP/voltalef UF 300 system. ^{233} Pa was selectively retained on column from 10 M HCl solutions and eluted with 3 M HCl. (author).

6103 (INIS-BR–3086) **Plutonium removal by ion exchange chromatography.** Araujo, B.F. de; Matsuda, H.T.; Carvalho, E.I. de; Araujo, I.C. de. Instituto de Pesquisas Energeticas e Nucleares (IPEN), Sao Paulo, SP (Brazil). 1991[12] (In Portuguese). (CONF-9110453–: 31. Brazilian Congress on Chemistry, Recife (Brazil), 21-25 Oct 1991). Order Number DE93608792. Source: OSTI; NTIS (US Sales Only); INIS.

A study for plutonium recovery at trace level from uranium solutions by ion exchange technique is presented. Plutonium retention > 99,5% onto strong anionic resin, AG-X8, from nitric acid solutions and a 92% recovery using 0,4 H NO_3 at 60^0 C as eluent, were obtained. Uranium interference on the plutonium sorption from mixed U-Pu nitrate solutions with low U/Pu ratio (≈ 25) was not verified. However, for high U/Pu ratio solutions (≈ 10000), uranium interferes on the plutonium retention onto resin, decreasing to 59%. Selecting the loaded conditions and using AG-X4 resin, 99% plutonium retention was achieved. The plutonium product is still contaminated with U and other purification cycle is recommended. A scheme for U-Pu first cycle separation is proposed. (author).

6104 (INIS-BR–3087) **Radiochemical techniques and activation analysis used in archaeology and art.** Vasconcellos, M.B.A.; Lima, F.W. Instituto de Pesquisas Energeticas e Nucleares (IPEN), Sao Paulo, SP (Brazil). 1987[13] (In Portuguese). Order Number DE93608752. Source: OSTI; NTIS (US Sales Only); INIS.

A review about the utilization of neutron activation analysis in cultural objects and archaeology is presented. (E.G.).

6105 (INIS-BR–3090) **Radiochemical analysis of phosphorus in milk samples.** Oliveira, R.M. de (Instituto de Pesquisas Energeticas e Nucleares (IPEN), Sao Paulo, SP (Brazil)); Cunha, I.I.L. Sociedade Brasileira de Quimica, Araraquara, SP (Brazil). 1991[4] (In Portuguese). (CONF-9109409–: 6. national meeting on analytical chemistry, Araraquara (Brazil), 3-6 Sep 1991). Order Number DE93608753. Source: OSTI; NTIS (US Sales Only); INIS.

The determination of phosphorus in milk samples by thermal neutron activation analysis employing radiochemical separation is described. The radiochemical separation consists of the simultaneous irradiation of samples and standards, dissolution of the milk samples in a perchloric acid and nitric acid mixture, addition of zinc hold-back carrier, precipitation of phosphorus as ammonium phospho molybdate (A.M.P.) and sample counting in a Geiger-Mueller detector. The analysis sources of error were studied and the established method was applied to phosphorus analyses in commercial milk samples. (author).

6106 (INIS-BR–3096) **Zirconium determination in refractories (gravimetric method).** Capiotto, N. (Companhia Siderurgica Paulista (COSIPA), Cubatao, SP (Brazil)); Narahashi, Y.; Perish, C.G.; Souza, J.R. Associacao Brasileira de Metais (ABM), Sao Paulo, SP (Brazil). 1991[15] (CONF-910011–: 8. seminar on chemical control on metallurgy and the 4th meeting on carbochemistry, Rio de Janeior (Brazil), 1991). Order Number DE93608775. Source: OSTI; NTIS (US Sales Only); INIS.

The zirconium determination in refractories is described, consisting in two separation methods for eliminating the interferences. The formatted product is calcined at 1100^0 C and determined gravimetrically as Zr P z 07. (author).

6107 (INIS-mf–13386, pp. 157-165) **Development of flow injection analysis technique for uranium estimation.** Paranjape, A.H. (Bhabha Atomic Research Centre, Bombay (India). Fuel Reprocessing Div.); Pandit, S.S.; Shinde, S.S.; Ramanujam, A.; Dhumwad, R.K. Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences. 1991. [472] (CONF-8912172–: International symposium on uranium technology, Bombay (India), 13 Dec 1989). In *Proceedings of the international symposium on uranium technology [held at Bombay during 13-15 Dec 1989]. V. 1.* Order Number DE93608776. Source: OSTI; NTIS (US Sales Only); INIS.

Flow injection analysis is increasingly used as a process control analytical technique in many industries. It involves injection of the sample at a constant rate into a steady flowing stream of reagent and passing this mixture through a suitable detector. This paper describes the development of such a system for the analysis of uranium (VI) and (IV) and its gross gamma activity. It is amenable for on-line or automated off-line monitoring of uranium and its activity in process streams. The sample injection port is suitable for automated injection of radioactive samples. The performance of the system has been tested for the colorimetric response of U(VI) samples at 410 nm in the range of 35 to 360mg/ml in nitric acid medium using Metrohm 662 Photometer and a recorder as detector assembly. The precision of the method is found to be better than +/- 0.5%. This technique with certain modifications is used for the analysis of U(VI) in the range 0.1-3mg/ailq. by alcoholic thiocynate procedure within +/- 1.5% precision. Similarly the precision for the determination of U(IV) in the range 15-120 mg at 650 nm is found to be better than 5%. With NaI well-type detector in the flow line, the gross gamma counting of the solution under flow is found to be within a precision of +/- 5%. (author). 4 refs., 2 figs., 1 tab.

6108 (INIS-mf–13386, pp. 166-181) **Standardization of a D.C. arc carrier-distillation procedure on a direct reading spectrometer for the determination of B, Cd etc., in nuclear grade uranium.** Biswas, S.S. (Bhabha Atomic Research Centre, Bombay (India). Spectroscopy Div.); Murty, P.S.; Marathe, S.M.; Sethumadhavan, A.; Dixit, V.S.; Kaimal, R.; Sankaran, A.V. Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences. 1991. [472] (CONF-8912172–: International symposium on uranium technology, Bombay (India), 13 Dec 1989). In *Proceedings of the international symposium on uranium technology [held at Bombay during 13-15 Dec 1989]. V. 1.* Order Number DE93608776. Source: OSTI; NTIS (US Sales Only); INIS.

Direct reading optical emission spectrometers which use photomultiplier tubes as detectors enable rapid analysis compared to spectrographs in which photographic emulsions are used for recording the spectrum. However, the use of direct reading spectrometers in conjunction with d.c. arc excitation source, is limited, since it is not possible to measure simultaneously the intensity of a line and its adjacent background with these spectrometers. Due to the high background (b.g.) associated with d.c arc spectra it is essential to apply b.g. correction to obtain net line intensities. Since dynamic b.g. correction is not possible different approaches are adopted by different workers to correct for the b.g. After several experiments, it was found that 'blank subtraction method' works well to give b.g corrected intensities. In this paper, details of a d.c. arc carrier-distillation procedure standardized on a Jobin-Yvon model, JY-48 direct reading polychromator is presented for the determination of eleven trace impurities such as B, Cd etc., in refractory U_3O_8 which is obtained after igniting uranium metal. (author). 5 refs., 7 tabs., 8 figs.

6109 (INIS-mf–13386, pp. 182-188) **Spectrographic determination of B, Cd and Ni in magnesium fluoride.** Sethumadhavan, A. (Bhabha Atomic Research Centre, Bombay (India). Spectroscopy Div.); Dixit, V.S.; Murty, P.S. Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences. 1991. [472] (CONF-8912172–: International symposium on uranium technology, Bombay (India), 13 Dec 1989). In *Proceedings of the international symposium on uranium technology [held at Bombay during 13-15 Dec 1989]. V. 1.* Order Number DE93608776. Source: OSTI; NTIS (US Sales Only); INIS.

An emission spectrographic method was developed for the determination of B, Cd and Ni in magnesium fluoride used as lining in the preparation of nuclear grade uranium. It becomes particularly necessary to determine B and Cd since their presence in MgF_2 will result in the production of uranium that contains more than acceptable concentration of these elements. In the present method, MgF_2 sample was mixed with pure conducting graphite powder which served as buffer, and excited in a d.c. arc operated at 10A. The spectra of sample and those of a set of synthetic standards were recorded on a Hilger's large quartz spectrograph in the wavelength region 2200-2850 A. Using B 2497.7 A, Cd 2288.0 A and Ni 2320.0 A lines for calibration with Ga as internal standard, detection limits of 1 p.p.m each for B, Cd and 10 p.p.m for Ni were obtained. The necessity of using a buffer for exciting MgF_2 in d.c. arc are emphasized in the present paper. This method is being routinely employed for the analysis of MgF_2 samples received from Uranium Metal Plant. (author). 4 refs., 3 figs., 2 tabs.

6110 (INIS-mf–13386, pp. 369-375) **Determination of uranium in sea water by adsorptive differential pulse voltametry.**

Khandekar, R.N. (Bhabha Atomic Research Centre, Bombay (India). Pollution Monitoring Section); Raghunath, Radha. Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences. 1991. [472] (CONF-8912172–: International symposium on uranium technology, Bombay (India), 13 Dec 1989). In *Proceedings of the international symposium on uranium technology [held at Bombay during 13-15 Dec 1989]. V. 1.* Order Number DE93608776. Source: OSTI; NTIS (US Sales Only); INIS.

An adsorptive stripping voltametric procedure for direct determination of trace quantities of uranium in sea water has been described. Optimal conditions include pH 6.7, 2 x 10^{-5}M 8-hydroxy quinoline (oxine) and collection potential of -0.4V (Vs Ag/AgCl) at hanging mercury drop electrode. With controlled adsorptive accumulation for one minute a detection limit of 2.8 x 10^{-10}M uranium is obtained. The response is linear upto 7 x 10^{-8}M uranium and the relative standard deviation at 4 x 10^{-9}M is 11.5%. The effect of possible interference from other metals has been investigated. (author). 14 refs., 1 tab.

6111 (LA-UR–92-3940) **Laser-induced breakdown spectroscopy for remote elemental analysis of planetary surfaces.** Blacic, J.D. (Los Alamos National Lab., NM (United States)); Pettit, D.R.; Cremers, D.A.; Roessler, N. Los Alamos National Lab., NM (United States). [1992]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9211130–3: International symposium on spectral sensing research, Maui, HI (United States), 15-20 Nov 1992). Order Number DE93003865. Source: OSTI; NTIS; GPO Dep.

One of the most fundamental pieces of information about any planetary body is the elemental and mineralogical composition of its surface materials. We are developing an instrument to obtain such data at ranges of up to several hundreds of meters using the technique of Laser-Induced Breakdown Spectroscopy, or LIBS. The elemental analysis is based on atomic emission spectroscopy of a laser-induced plasma or spark. A pulsed, diode-pumped ND:YAG laser of several hundred mJ optical energy is used to vaporize and electronically excite the constituent elements of a rock surface remotely located from the laser. Light emitted from the excited plasma is collected and introduced to the entrance slit of a small grating spectrometer. The spectrally dispersed spark light is detected with either a linear photo diode array or area CCD array. When the latter detector is used, the optical and spectrometer components of the LIBS instrument can also be used in a passive imaging mode to collect and integrate reflected sunlight from the same rock surface. Absorption spectral analysis of this reflected light gives mineralogical information that, when combined with the elemental analysis from the LIBS mode, provides a complete remote geochemical characterization of the rock surface. We have performed laboratory calibrations in air and in vacuum on standard rock powders to quantify the LIBS analysis. We have performed a preliminary field test using commonly available laboratory components to demonstrate remote LIBS analysis of terrestrial rock surfaces at ranges of over 25 meters. Based on these results, we believe that all major and most minor elements expected on planetary surfaces can be measured with absolute accuracy of 10–15% and much higher relative accuracy.

6112 (LBL–32920) **A photon phreak digs the LDEF happenings.** Smith, A.R.; Hurley, D.L. Lawrence Berkeley Lab., CA (United States). Jun 1992. 10p. Sponsored by National Aeronautics and Space Administration, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-9206240–2: 2. Long Duration Exposure Facility (LDEF) post-retrieval symposium, San Diego, CA (United States), 1-5 Jun 1992). Order Number DE93004783. Source: OSTI; NTIS; GPO Dep.

A year ago at the First LDEF Post-Retrieval Symposium, we reported detailed measurements on trunnion sections, as well as results from "intentional" samples (Co, Ni, In, Ta, and V) and spacecraft parts. For this year's Symposium we re-evaluate some of these findings in combination with more recent results, to cast a longer perspective on the LDEF experience, and to sketch some promising avenues toward more effective participation in future missions. The LDEF analysis effort has been a superb training exercise, from which lessons learned needs be applied to future missions – right back to the early phases of mission planning.

6113 (LW–1992-1) **Development of a multi-method for a simultaneous routine determination of pesticides, metabolites and polychlorinated biphenyls in drinking water with HPLC. Final report.** Werner, G. Zweckverband Landeswasserversorgung, Stuttgart (Germany); Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Mar 1992. 263p. (In German). Contract BMFT 02WT8924. Order Number DE93750596. Source: OSTI; NTIS (US Sales Only).

Following on from the earlier work of the Zweckverband Landeswasserversorgung (Regional Water Supply Association), a multi-method system for determination of pesticides based on solid phase extraction/HPLC (high pressure liquid chromatography) was developed and refined. This method makes possible the simultaneous proof of absence of almost 200 pesticides and metabolites, without derivatisation and with only 2 courses of analysis, in a practicable form which is well-suited to routine analytical procedures. At the same time any pesticides and metabolites present can also be identified and quantitatively detected in concentrations 0.1 μg/l. Using the results of the investigations which were carried out in order to optimise solid phase extraction whilst taking into consideration the extraction ph value, it is now possible to calculate the amount of C18 material required for quantitative extraction of a substance. For optimum detection of extractable substances, extractions both at pH = 7 and 2.0 are necessary, although in some cases a single extraction at ph = 2.8 can also be employed. 224 substances were included in the investigations, of which 189 proved to be detectable by means of the multi-method procedure. Thus, in combination with the GC (gas chromatography) or the GC/MS (gas chromatography mass spectrometer), this procedure allows a significant simplification of the detection of substances listed under no 13, Appendix 2, of the Drinking Water Regulations (Trinkwasserverordnung). (orig.) With 14 refs., 19 tabs., 20 figs.

6114 (ORNL/M–1741) **The High Temperature Materials Laboratory: A research and user facility at the Oak Ridge National Laboratory.** Oak Ridge National Lab., TN (United States). [1992]. 57p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93003592. Source: OSTI; NTIS; GPO Dep.

HTML is a modern facility for high-temperature ceramic research; it is also a major user facility, providing industry and university communities access to special research equipment for studying microstructure and microchemistry of materials. User research equipment is divided among six User Centers: Materials Analysis, X-ray Diffraction, Physical Properties, Mechanical Properties, Ceramic Specimen Preparation, and Residual Stress. This brochure provides brief descriptions of each of the major research instruments in the User Centers: scanning Auger microprobe, field emission SEMs, electron microprobe, multitechnique surface analyzer, analytical electron microscope, HRTEM, optical microscopy & image analysis, goniometer, scanning calorimetry, simultaneous thermal analysis, thermal properties (expansion, diffusivity, conductivity), high-temperature tensile test facilities, flexure, electromechanical test facilities (flexure, compression creep, environmental), microhardness microprobe, ceramic machining. Hands-on operation by qualified users is encouraged; staff is available. Both proprietary and nonproprietary research may be performed; the former on full cost recovery basis.

6115 (SAND–92-2079C) **Diffraction peaks in x-ray spectroscopy: Friend or foe?.** Tissot, R.G.; Goehner, R.P. Sandia National Labs., Albuquerque, NM (United States). [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9208129–6: Annual Denver x-ray conference, Denver, CO (United States), 3-7 Aug 1992). Order Number DE93002482. Source: OSTI; NTIS; INIS; GPO Dep.

Diffraction peaks can occur as unidentifiable peaks in the energy spectrum of an x-ray spectrometric analysis. Recently, there has been increased interest in oriented polycrystalline films and epitaxial films on single crystal substrates for electronic applications. Since these materials diffract x-rays more efficiently than randomly oriented polycrystalline materials, diffraction peaks are being observed more frequently in x-ray fluorescent spectra. In addition, micro x-ray spectrometric analysis utilizes a small, intense, collimated x-ray beam that can yield well defined diffraction peaks. In

some cases these diffraction peaks can occur at the same position as elemental peaks. These diffraction peaks, although a possible problem in qualitative and quantitative elemental analysis, can give very useful information about the crystallographic structure and orientation of the material being analyzed. The observed diffraction peaks are dependent on the geometry of the x-ray spectrometer, the degree of collimation and the distribution of wavelengths (energies) originating from the x-ray tube and striking the sample.

6116 (UCRL–53943-91, pp. 16-18) **Atomic-resolution imaging with photoelectron holography.** Barton, J.J. (IBM Research, Yorktown Heights, NY (United States)); Terminello, L.J. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

The authors have imaged copper atoms near a (100) single-crystal face using photoelectron holography. The Cu 3p hologram, measured at 577 eV using synchrotron radiation, was two-dimensionally Fourier transformed to obtain three dimensions of atomic structural information. This structural technique can then be used to better understand solid-state atomic interactions with future applications.

6117 (UCRL–53943-91, pp. 161-163) **New analytical approach for screening and identifying trace levels of nitrogen-containing compounds.** Alcaraz, A.; Martin, W.H.; Andresen, B.D. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

The authors developed a new approach for screening and identifying nitrogen-containing explosives and illicit drugs. This trace-component analysis simultaneously links capillary gas chromatography (GC) to both a thermal energy analyzer (TEA) and an ion trap mass spectrometer (ITMS). The new GC-TEA/ITMS system can screen for and identify trace levels of nitrogen-containing compounds. The TEA is a highly specific nitrogen detector that is used to locate the nitrogen-containing compounds in a total ion chromatogram (TIC). The ITMS can confirm known components and identify unknown chemicals. Both instrumental methods, when linked, have ultra-trace detection levels in the picogram range (10^{-12}g).

6118 (UCRL–53943-91, pp. 164-166) **Bio-organic molecules on surfaces: Atomic structure of ordered monolayers of adenine on graphite by scanning tunneling microscopy and analysis of sperm nuclear volumes by atomic force microscopy.** Siekhaus, W.J. (Lawrence Livermore National Lab., CA (United States)); Balooch, M.; Tench, R.J.; Balhorn, R.; Allen, M.J.; Hud, N.V.; Lee, C.; Pogany, G.; Subbiah, S. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

The authors have applied scanning probe microscopy to biomolecules of widely different size. On the angstrom scale, the authors have examined the molecular arrangements of adenine and thymine (two of the four DNA bases that comprise the genetic code) attached to the basal plane of highly oriented pyrolytic graphite. Both molecules form highly organized lattices. Images of these molecules at atomic resolution reveal that the aromatic regions are strongly detected in both molecules, whereas the various side-groups are not well resolved. These studies provide the first evidence that tunneling microscopy can be used to discriminate between purines and pyrimidines. On the micrometer scale, the authors have determined the volumes of individual mouse and bull sperm nuclei both dried in air and fully hydrated in a fluid cell. Sperm nuclei are shown to expand significantly upon hydration, contradicting previous serial section results by electron microscopy.

6119 (UJV–9581-CH) **Current situation of expeditious radiochemical ^{90}Sr and ^{89}Sr determination in environmental objects.** Kyrs, M.; Selucky, P. Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia). Dec 1991. [76] (In Czech). Order Number DE93608794. Source: OSTI; NTIS (US Sales Only); INIS.

The compilation gives a survey of methods for ^{90}Sr and ^{89}Sr determination. Methods based on liquid scintillators and the Cherenkov radiation are enjoying progress. Precipitation processes are superseded by extraction methods, which contribute to rapidity of the analysis. Crowns (cyclic ethers) seem to be the most promising reagents for strontium separation. For the various measuring methods a large number exists of relations for the calculation of strontium activity. Brief information is presented on the occurrence and properties of strontium and its behavior in living organisms. Examples are given of the determination of radiostrontium in seawater, precipitations, in plants, teeth, milk, in mammal tissues and in soil. Sources of error and analytical quality assurance problems are discussed. (M.D.). 11 tabs., 136 refs.

6120 (WSRC-MS–92-280) **Analysis of Iodine-129 in aqueous samples by inductively coupled plasma-mass spectrometry.** Beals, D.M. (Westinghouse Savannah River Co., Aiken, SC (United States)); Chastagner, P.; Turner, P. Westinghouse Savannah River Co., Aiken, SC (United States). [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-9211116–2: 38. annual conference on bioassay, analytical and environmental radiochemistry, Santa Fe, NM (United States), 2-6 Nov 1992). Order Number DE93002694. Source: OSTI; NTIS; GPO Dep.

An inductively coupled plasma - mass spectrometry (ICP-MS) method was developed to determine the ^{129}I content in aqueous environmental samples. Due to interference from xenon, direct measurement of ^{129}I could not be made on the ICP-MS. An ion-exchange technique is used to concentrate the Iodine from one liter samples to 30 mL. The 30 mL eluant from the anion-exchange column is then introduced to the ICP-MS. The detection limit of the procedure is $\leq$0.5 pCi/L. Several samples from the Savannah River near the Savannah River Site (SRS) have been analyzed for ^{129}I by this procedure. Concentrations of ^{129}I in the Savannah River ranged from 0.05$\pm$0.12 to 0.21$\pm$0.49 pCi/L (95% CL). Below a seepage basin, in Four Mile Creek on the Savannah River Site, ^{129}I concentrations were as high as 2.31$\pm$1.22 pCi/L. Before exiting the SRS the ^{129}I concentration had decreased to 0.30$\pm$0.16 pCi/L by dilution in Four Mile Creek.

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Refer also to citation(s) 4844, 4902, 4949, 4950, 4951, 5173, 5346, 5373, 5375, 5821, 5937, 5940, 6018, 6044, 6047, 6077, 6483, 6518, 6526, 6651, 6662, 7399

6121 (AEA-RS–5166) **The role of boric acid in the Phebus-FP tests.** Bowsher, B.R. AEA Reactor Services, Winfrith (United Kingdom). Dec 1991. [42] Order Number DE93608798. Source: OSTI; NTIS (US Sales Only); INIS.

The data in this report should enable proposed methods for the introduction of boric acid into the Phebus-FP tests to be assessed. Boric acid chemistry is reviewed in the condensed, vapour and aqueous phases. The chemistry of concentrated aqueous solutions of boric acid is complex, involving polyborate species resulting in enhanced acidities. Equations are presented that allow the partition of boric acid between the vapour and aqueous phase to be calculated at different boric acid concentrations. The volatility of boric acid is enhanced significantly in the presence of steam. Equations are given that allow the effective vapour pressure of boric acid to be determined as functions of the water vapour pressure for temperatures in the range from 723 to 1000°C. These data are confirmed by experimental studies designed to simulate specific aspects of the conditions in the Phebus-FP tests. (author).

6122 (ANL/CMT/CP–77775) **Many-body effects in $Cu^{2+}(H_2O)_m$ clusters.** Curtiss, L.A. (Argonne National Lab., IL (United States)); Rodriguez, W. Argonne National Lab., IL (United States). Oct 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-921036–10: 182. meeting of the Electrochemical Society, Toronto (Canada), 11-16 Oct 1992). Order Number DE93002988. Source: OSTI; NTIS; GPO Dep.

The importance of many-body interactions is investigated for m=4,6,8 in $Cu^{2+}(H_2O)m$ clusters using ab initio molecular orbital theory. A slow convergence of the interaction terms to the full many-body result is found similar to what was found in a previous

study of $Fe^{3+}(H_2O)m$ clusters. Implications for molecular dynamics and Monte Carlo simulations are discussed.

6123 (BNL–48058) **Laue diffraction as a tool in dynamic studies: Hydrolysis of a transiently stable intermediate in catalysis by trypsin.** Singer, P.T. (Brookhaven National Lab., Upton, NY (United States)); Berman, L.E.; Cai, Z.; Mangel, W.F.; Jones, K.W.; Sweet, R.M.; Carty, R.P.; Schlichting, I.; Stock, A. Brookhaven National Lab., Upton, NY (United States). [1992]. 28p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9201120–1: Royal Society discussion meeting on time resolved macromolecular crystallography, London (United Kingdom), 29-30 Jan 1992). Order Number DE93003141. Source: OSTI; NTIS; INIS; GPO Dep.

A transiently stable intermediate in trypsin catalysis, guanidinobenzyol-Ser-195 trypsin, can be trapped and then released by control of the pH in crystals of the enzyme. This effect has been investigated by static and dynamic white-beam Laue crystallography. Comparison of structures determined before and immediately after a pH jump reveals the nature of concerted changes that accompany activation of the enzyme. Careful analysis of the results of several structure determinations gives information about the reliability of Laue results in general. A study of multiple exposures taken under differing conditions of beam intensity, crystal quality, and temperature revealed information about ways to control damage of specimens by the x-ray beam.

6124 (CONF-921230–1) **Methods for predicting properties and tailoring salt solutions for industrial processes.** Ally, M.R. Oak Ridge National Lab., TN (United States). [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From National Aeronautics and Space Administration (NASA) technology 2002 conference; Baltimore, MD (United States); 1-3 Dec 1992. Order Number DE93003028. Source: OSTI; NTIS; GPO Dep.

An algorithm developed at Oak Ridge National Laboratory accurately and quickly predicts thermodynamic properties of concentrated aqueous salt solutions. This algorithm is much simpler and much faster than other modeling schemes and is unique because it can predict solution behavior at very high concentrations and under varying conditions. Typical industrial applications of this algorithm would be in manufacture of inorganic chemicals by crystallization, thermal storage, refrigeration and cooling, extraction of metals, emissions control, etc. 3 figs, 2 tabs, 1 ref.

6125 (DOE/ER/13480–3) **Analysis of forward and inverse problems in chemical dynamics and spectroscopy: Summary report, February 1, 1990–August 1, 1992.** Rabitz, H. Princeton Univ., NJ (United States). Dept. of Chemistry. [1992]. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-86ER13480. Order Number DE93005871. Source: OSTI; NTIS; GPO Dep.

The forward aspects of the research were concerned with mapping the relation between input potential surface structure, and laboratory dynamical and kinetic observables. The research on inverse analysis complemented the forward analysis studies; objective was to develop algorithms for inversion of quality laboratory data, back to underlying potential surfaces. 24 items of research in molecular dynamics and chemical kinetics are reported. The following collisions/reactions were studied: $H + H_2$, $He - H_2$, $He - Xe/C(0001)$, thermal explosions, $CO/H_2/O_2$, $H_2 + HD$, $H^+ + F(^2P_{1/2})$, $He^+ + Ne(2p^6)$, $Na + I$, $F + H_2$, $CO - H_2 - O_2$.

6126 (DOE/ER/13529–7) **Molecular orbital studies of the bonding in heavy element organometallics: Progress report.** Bursten, B.E. Ohio State Univ., Columbus, OH (United States). Dept. of Chemistry. 4 Dec 1992. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-86ER13529. Order Number DE93005291. Source: OSTI; NTIS; GPO Dep.

The upgrade to the DECstation 3100 (and other workstations underway) has enabled the use of more sophisticated electronic structure methods. Research were done in the following fields: tris(cyclopentadienyl) actinide complexes; actinide-containing molecules with metal-metal bonds (U dimer, Th-Ru, Zr-Ru); and applications of fully relativistic DV-Xα method to trivalent actinide chemistry (MCl_3).

6127 (DOE/ER/13649–T2) **Mechanisms of gas permeation through polymer membranes: Summary technical report, September 1991–August 1992.** Stern, S.A. Syracuse Univ., NY (United States). Dept. of Chemical Engineering and Materials Science. [1992]. 36p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-87ER13649. Order Number DE93005960. Source: OSTI; NTIS; GPO Dep.

Progress is reported in two areas: (1) Concentration-temperature superposition principle (CTSP). CTSP is a theoretical model for describing the gas solubility in glassy polymers swollen by the penetrant gas. It has been extended to describe the dependence of gas diffusivity and permeability on penetrant pressure. Further extension to diffusion of gas mixtures is being studied. (2)Solubility of gases in poly(alkyl methacrylates). Solubility of methane in poly(ethyl methacrylate) and poly(n-butyl methacrylate) was measured; the Langmuir capacity constant was found to not reflect a lower excess free volume; an equation is given for relating the constant to the glass transition temperature. Solubility of ethane in the latter polymer is affected by plasticization.

6128 (DOE/ER/13654–6) **Chemical interactions in multimetal/zeolite catalysts: Progress report, January 7, 1991–January 6, 1992.** Sachtler, W.M.H. Northwestern Univ., Evanston, IL (United States). 21 Dec 1992. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-87ER13654. Order Number DE93005133. Source: OSTI; NTIS; GPO Dep.

Research is proposed on two groups of zeolite based catalysts that contain two transition elements. In one group both metals are fully reduced, in the other group one element is left as a positive ion; it can act as a "chemical anchor", or as a catalyst promoter for the reduced metal. The objective is to explore the potential of such materials for designing superior catalysts for synthesis and conversion of hydrocarbons and other energy carriers. ENDOR, EXAFS, CO-FTIR and TPD will be used to identify the interaction of Mn^{2+} ions with Rh_n particles in the same zeolite cage. EXAFS at the Kedge of Fe and Pd, FTIR and Moessbauer spectroscopy will be used to characterize Fe ions and alloyed Fe atoms in PdFe/NaHY. The catalysts will be probed with CO hydrogenation and conversion of hydrocarbons. Methods Which proved successful in our study of Y supported bimetal systems will be applied to identify the state of Pt and Cu in ZSM-5, a catalyst system holding large promise for NO abatement, even in the presence of oxygen.

6129 (DOE/ER/13777–5) **Prediction of thermodynamic properties of coal derivatives: Annual technical report, March 1, 1992–February 28, 1993.** Donohue, M.D. Johns Hopkins Univ., Baltimore, MD (United States). Dept. of Chemical Engineering. Nov 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-87ER13777. Order Number DE93005720. Source: OSTI; NTIS; GPO Dep.

The purpose of this research program is to understand and model the effect of the different intermolecular forces on the thermodynamic properties of systems containing pure compounds and mixtures. The compounds under consideration vary considerably in size, shape and energy. Therefore in order to develop a theory capable of describing accurately the thermodynamic properties and phase behavior of such systems over a wide range of temperature and pressure, one has to take into account explicitly the differences in shape and size among the various compounds as well as the different type of intermolecular interactions. We have developed equations of state for pure-component chain molecules. We have shown that the excellent performance of complicated theories such as the Generalized Flory Dimer (GFD) theory can be mimicked by simpler equations, if certain assumptions for the shape parameters are made. We developed engineering correlations based on the GFD theory, using local composition theory to take into account the attractive contribution. We compared various methods for the calculation of the repulsive and attractive contributions against computer simulation data for hard and square-well chains, and experimental data from the literature. We also have studied microstructure and local order in fluids that contain asymmetric molecules. In addition, simple cubic equations of state have been applied to calculate physical and chemical-reaction equilibria

in non-ideal systems. In order to obtain a better understanding of the intermolecular forces and to test some of our recent models, we have performed considerable experimental work. We used FT-IR to examine the self-association of aliphatic alcohols due to hydrogen bonding. In addition, FT-IR spectroscopy was used to investigate Lewis acid-base interactions between probe and entrainer-cosolvent molecules.

6130 (DOE/ER/13836–5) **An investigation of catalytic active phase-support interactions by IR, NMR and x-ray absorption spectroscopies: Progress report, January 15, 1992–September 15, 1992.** Haller, G.L. Yale Univ., New Haven, CT (United States). Dept. of Chemical Engineering. Sep 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER13836. Order Number DE93005646. Source: OSTI; NTIS; GPO Dep.

Active catalytic phases (metal, mixed metals, oxide or mixed oxides) interacting with oxide support on which the active phase is dispersed can affect the percentage exposed, the morphology of supported particles, the degree of reducibility of cations, etc., in a variety of ways. Our objective is to characterize the physical chemistry of the active phase-oxide support interaction by spectroscopic methods and to correlate this structure with catalytic function. Two catalytic systems and their associated techniques (x-ray absorption and NMR) are discussed in this progress report. Firstly, the interaction of Pt-Ni supported on silica and L-zeolite are characterized and compared by x-ray absorption spectroscopy (EXAFS). Secondly, we present both experimental and calculational developments of NMR for the investigation of amorphous silica-alumina catalysts and/or supports.

6131 (DOE/ER/13848–5) **Charge separation in photoredox reactions: Progress report, October 1991–October 1992.** Kevan, L. Houston Univ., TX (United States). Dept. of Chemistry. Oct 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-88ER13848. Order Number DE93005885. Source: OSTI; NTIS; GPO Dep.

Electron donors/acceptors in micelle and vesicle interfaces' (in surfactants) were studied using ESR, deuterium electron spin echo modulation, and ENDOR. Compounds studied included x-doxylstearic acid, tetramethylbenzidine, alkylmethylviologens, alkylphenothiazines, etc.

6132 (DOE/ER/13935–T1) **Electrophilic metal alkyl chemistry in new ligand environments: Annual report, January 1, 1992–September 15, 1992.** Jordan, R.F. Iowa Univ., Iowa City, IA (United States). Dept. of Chemistry. [1992]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER13935. Order Number DE93005125. Source: OSTI; NTIS; GPO Dep.

Methods have been worked out for efficient synthesis of various N_4^{2-} macrocyclic ligands, neutral group 4 metal (e.g., Zr) $(N_4)MR_2$ complexes, and cationic mono-alkyl $(N_4)M(R)^+$ species. Intital indications are that the latter will be highly reactive in base-free form. Objective is to develop new types of electrophilic metal alkyl complexes for study of olefin polymerization and C-H activation catalysis.

6133 (DOE/ER/13954–4) **Correlations between surface structure and catalytic activity/selectivity: Progress report, January 1, 1992–December 31, 1992.** Goodman, D.W. Texas A and M Univ., College Station, TX (United States). Dept. of Chemistry. Oct 1992. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-88ER13954. Order Number DE93005884. Source: OSTI; NTIS; GPO Dep.

Objective is to address the keys to understanding the relation between surface structure and catalytic activity/selectivity. Of concern are questions related to enhanced catalytic properties of mixed-metal catalysts and critical active site requirements for molecular synthesis and rearrangement. The experimental approach utilizes a microcatalytic reactor contiguous to a surface analysis system, an arrangement which allows in vacuo transfer of the catalyst from one chamber to the other. Surface techniques being used include Auger (AES), UV and X-ray photoemission spectroscopy (UPS and XPS), temperature programmed desorption (TPD), low energy electron diffraction (LEED), high resolution electron energy loss spectroscopy (HREELS) and infrared reflection-absorption spectroscopy (IRAS). Our research program builds upon our previous experience relating the results of single crystal kinetic measurements with the results obtained with supported analogs. As well we are exploiting our recent work on the preparation, the characterization, and the determination of the catalytic properties of ultra-thin metal and metal oxide films. The program is proceeding toward the study of the unique catalytic properties of ultrathin metal films; the investigation of the critical ensemble size requirements for principal catalytic reaction types; and the modelling of supported catalysts using ultra-thin planar oxide surfaces.

6134 (DOE/ER/14048–T4) **Alkane activation and reactivity on iridium, platinum, and ruthenium surfaces.** Weinberg, W.H. California Univ., Santa Barbara, CA (United States). Dept. of Chemical and Nuclear Engineering. [1992]. 72p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-89ER14048. Order Number DE93005063. Source: OSTI; NTIS; GPO Dep.

We will study the dynamics and kinetics of molecular trapping, trapping-mediated activation, and direct dissociation of methane, ethane, propane, i-butane, and cyclopropane on the Ir(110)-(1 x 2), Ir(111), Pt(110)-(1 x 2), and Ru(001) surfaces. Both supersonic molecular beam scattering and "bulb" (microreactor) measurements will be made with evaluation of the reaction rates by mass spectrometry, Auger electron spectroscopy, and X-ray photoelectron spectroscopy. We will also quantify spectroscopically the rate coefficients of the elementary surface reactions that are extant (dehydrogenation, carbon-carbon bond cleavage, and hydrogenation with coadsorbed atomic hydrogen). The (vibrational) spectroscopies we will use are Fourier transform reflection-absorption IR and high-resolution electron energy loss spectroscopies. These results will provide a valuable quantification of both the reactivity and the selectivity of C-H bond activation for both trapping-mediated and direct dissociative chemisorption as a function of electronic and geometric structure within the Group VIII transition metals.

6135 (DOE/ER/45120–11) **Systematic preparation of selective heterogeneous catalysts: Final report, September 1, 1984–August 31, 1991.** Augustine, R.L. Seton Hall Univ., South Orange, NJ (United States). Dept. of Chemistry. 7 Nov 1991. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-84ER45120. Order Number DE93005065. Source: OSTI; NTIS; GPO Dep.

The Single Turnover (STO) procedure, involving pulses of hydrogen and 1-butene, was developed for studying the types of active sites present on supported metal catalysts. The STO procedure was used to study direct saturated sites and other topics. Frontier molecular orbital studies were also made.

6136 (DOE/ER/45374–1) **Investigations of the effects of isotopic substitution and pressure of miscibility in polymer-polymer and polymer-solvent systems: Technical progress report, March 1991–March 1992.** Van Hook, A. Tennessee Univ., Knoxville, TN (United States). Dept. of Chemistry. [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-88ER45374. Order Number DE93005115. Source: OSTI; NTIS; GPO Dep.

Design, construction, and calibration of the polymer-solvent light scattering apparatus is complete. Preliminary results for the polystyrene-acetone system have been reported; theory has been developed also. Measurements on the polystyrene-acetone and polystyrene-methyl cyclopentane systems have been completed (abstract is included). Near tri-critical behavior is exhibited in the acetone-polystyrene system in its hypercritical point. Data on phase separation in polymer-polymer solutions by light scattering using spinodal quench techniques have been obtained. Methods have been worked out to synthesize perdeutero-methylcyclopentane and 1,1-dideuteropropionitrile. A review article has been prepaired summarizing the field of isotopomer solution thermodynamics.

6137 (DOE/ER/60648–5) **[Studies of the formation chemical reactivity and properties of small clusters application to an understanding of aerosol formation and heterogeneous chemistry].** Castleman, A.W. Jr. Pennsylvania State Univ., University Park, PA (United States). [1992]. 18p. Sponsored by USDOE,

Washington, DC (United States). DOE Contract FG02-88ER60648. Order Number DE93005920. Source: OSTI; NTIS; GPO Dep.

Chemical reactions that proceed following either a photophysical or ionizing event, are directly influenced by the mechanisms of energy transfer and dissipation away from the primary site of absorption. Neighboring solvent or solute molecules can affect this by collisional deactivation (removal of energy), through effects in which dissociating molecules are kept in relatively close proximity for comparatively long periods of time due to the presence of the solvent, and in other ways where the solvent influences the energetics of the reaction coordinate. Research on clusters offers one of the most viable ways of elucidating the molecular details of these processes. The current program is comprised of three general areas of research. Investigation of the dynamics of ionization and the mechanisms of the early-time reactions following the interaction of ionizing electromagnetic radiation with matter; measurement of the kinetics of ensuing ion reactions with effort focused on the influence of solvation effects and identifying similarities and differences between gas and condensed phase reactions; and determination of the structure of solvated reaction centers via spectroscopy, dynamics and thermochemistry.

6138 (DOE/MC/26039–3111) **Methane oxidation over dual redox catalysts: Final report.** Klier, K.; Herman, R.G.; Sojka, Z.; DiCosimo, J.I.; DeTavernier, S. Lehigh Univ., Bethlehem, PA (United States). Zettlemoyer Center for Surface Studies. Jun 1992. 135p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG21-89MC26039. Order Number DE92012454. Source: OSTI; NTIS; GPO Dep.

Catalytic oxidation of methane to partial oxidation products, primarily formaldehyde and C_2 hydrocarbons, was found to be directed by the catalyst used. In this project, it was discovered that a moderate oxidative coupling catalyst for C_2 hydrocarbons, zinc oxide, is modified by addition of small amounts of Cu and Fe dopants to yield fair yields of formaldehyde. A similar effect was observed with Cu/Sn/ZnO catalysts, and the presence of a redox Lewis acid, Fe^{III} or Sn^{IV}, was found to be essential for the selectivity switch from C_2 coupling products to formaldehyde. The principle of double doping with an oxygen activator (Cu) and the redox Lewis acid (Fe, Sn) was pursued further by synthesizing and testing the CuFe-ZSM-5 zeolite catalyst. The Cu^{II}(ion exchanged) Fe^{III}(framework)-ZSM-5 also displayed activity for formaldehyde synthesis, with space time yields exceeding 100 g/h-kg catalyst. However, the selectivity was low and earlier claims in the literature of selective oxidation of methane to methanol over CuFe-ZSM-5 were not reproduced. A new active and selective catalytic system (M=Sb,Bi,Sn)/SrO/La_2O_3 has been discovered for potentially commercially attractive process for the conversion of methane to C_2 hydrocarbons, (ii) a new principle has been demonstrated for selectivity switching from C_2 hydrocarbon products to formaldehyde in methane oxidations over Cu,Fe-doped zinc oxide and ZSM-5, and (iii) a new approach has been initiated for using ultrafine metal dispersions for low temperature activation of methane for selective conversions. Item (iii) continues being supported by AMOCO while further developments related to items (i) and (ii) are the objective of our continued effort under the METC-AMOCO proposed joint program.

6139 (DOE/PC/91303–T3) **Semiconductor electrochemistry of coal pyrite: Technical progress report, April–June 1992.** Osseo-Asare, K.; Wei, D. Pennsylvania State Univ., University Park, PA (United States). Dept. of Materials Science and Engineering. [1992]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-91PC91303. Order Number DE93004927. Source: OSTI; NTIS; GPO Dep.

Pyrite synthesis is of interest in many diverse fields, such as geology, fuel processing technology, chemistry, metallurgy, materials science, and so on. Based on fundamental studies of this process, the formation mechanisms of this important sulfide on the earth can be better understood. The studies can also help us to better understand the surface chemistry and electrochemistry of pyrite, thereby assisting in the development of more efficient processes for removal of the sulfide from coal. The work performed during this quarter focuses on the study of the reaction between aqueous sulfide ions and dissolved Fe(II) salts by using a stopped-flow spectrophotometric technique. At a wavelength of 500 mn, no absorption was observed with either aqueous sulfide or dissolved Fe(II) salt alone. However, when the two solutions were mixed, a strong absorbance appeared at the same wavelength. The absorbance-time curve showed that a black material formed at the first few seconds of the reaction, then this material decayed and changed gradually to a lighter dark material within the following several minutes. These processes were pH-dependent. It was more likely to form the black intermediate at the pH range from 7 to 8. This indicates that the reaction between Fe^{2+} and HS^- results in the formation of the black intermediate because in this pH range, both Fe^{2+} and HS^- are the predominant species. The absorbance varied linearly with the concentration of the reactant for the first step of the reaction. The absorptivity of the black intermediate was determined as 4800 l/mol/cm. By means of this spectrophotometric technique, the stoichiometry, the equilibrium constant and the rate constant of the reaction will be determined.

6140 (ETDE-mf–93742725) **Kinetic investigation of the reaction of the CH($X^2\Pi$) radical with molecular hydrogen.** Bergische Universitaet Gesamthochschule Wuppertal - Fachbereich 9 - Physikalische Chemie. Bericht. Becker, K.H.; Kurtenbach, R. Wuppertal Univ. (Gesamthochschule) (Germany). Lehrgebiet Physiaklische Chemie. Jun 1991 44p. (In German). Order Number DE93742725. Source: OSTI; NTIS (US Sales Only).

This work investigates the pressure and temperature dependence of the reaction CH($X^2\Pi$)+ H_2. The parameters obtained are in good agreement with the data from literature. The simulation of the temperature dependence carried through with the aid of the transition state model yields a good description, both qualitatively and quantitatively, of the experimental results. (orig.).

6141 (ETDE-mf–93744297) **Formation and chemical characteristics of coke deposits in typical hydrocarbon reactions on acid monofunctional zeolite catalysts. Final report.** Karge, H.G. Fritz-Haber-Institut der Max-Planck-Gesellschaft, Berlin (Germany); Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Nov 1989 22p. (In German). Contract BMFT 03C111;BMFT 03C231. Order Number DE93744297. Source: OSTI; NTIS (US Sales Only).

The formation of coke in the reactions of ethyl benzole, ethylene, n-decane and methanol was studied via acid forms of zeolith catalysts (H-Mordenite, H-ZSM-5, La, Na-Y) with the aid of gravimetric, mass spectrometer, spectroscopic and conversion measurements. The effect of the reaction temperature and the acidity of the catalysts were specially examined. The different methods led to the same result, that one must distinguish between at least two considerably different forms of coke deposits, the socalled type I and type II coke. Type I is generally produced at low reaction temperatures, i.e.: below 500 K, has an H/C ratio of 2>H/C>1 and is characterized by radicals, while coke of type II is produced above 500 K and contains mainly aromatic hydrocarbons. (orig./EF).

6142 (ETDE-mf–93744366, pp. 16-20) **Preparation and analysis of a diesel exhaust particulate extract for the determination of a toxicity profile.** Levsen, K. (Fraunhofer-Inst. fuer Toxikologie und Aerosolforschung, Hannover (Germany)). GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Forschungszentrum Juelich GmbH (Germany). Projekttraeger Biologie, Energie, Oekologie; Bundesministerium fuer Forschung und Technologie, Bonn (Germany). 1992. 62p. (In German). In *Health effects of diesel exhaust gases. 5 years of research promotion.* Order Number DE93744366. Source: OSTI; NTIS (US Sales Only).

The test block installed for this study incorporated a 1.6 l Volkswagen diesel engine, an eddy-current brake and exhaust pipe with an attached diluting tunnel to allow the exhaust gases to cool. With the aid of this set-up 20 grammes of diesel exhaust particulate were taken up on glass fibre filters according to the procedure described in the previous chapter. The particulate thus obtained was used to examine the effects that diesel exhaust particles, diesel exhaust extract and five individual fractions would exert on cell cultures. The fractions were made up of substances from the classes of alkanes, polycyclic armoatic hydrocarbons (PAH), mononitro-derivatives of PAH, oxidised PAH and dinitro-derivatives of PAH as well as of a number of polar compounds. In order to ensure that all

analyses were carried out with uniform test material throughout the study period, an extract in 2 l toluene was prepared from the total amount of particulate, which was stored in the dark and occasionally examined for changes in quality and composition. (orig./BBR).

6143 (IFP–40036) **Elaboration of catalysts with silica and silica-alumina matrices.** Paris-6 Univ., 75 (France); Institut Francais du Petrole (IFP), 92 - Rueil-Malmaison (France). Jul 1992. 259p. (In French). Source: OSTI; NTIS (US Sales Only).

The present work is a study of each step of the process of preparation of catalysts with silica and silica-alumina matrices. The influence of operating variables on catalyst texture at each step of the process is analysed. Firstly, it has been necessary to study the textural determinations: a calorimetric method, thermoporometry, has been used. To our knowledge, it is the only technic available for wet materials (hydrogels) and dry materials (xerogels). The first step of the process is silica gelation. This unit operation has a crucial influence on the texture. The strategy of experimental design theory has been employed to underscore the important effect of the following parameters: temperature, pH, silica content in silica hydrogel, silica-alumina ratio. The results are described by a polynomial model, which predicts final product texture. As demonstrated in this work, the other unit operations (filtration, washing, spray-drying) can modify the texture of the solid. 147 refs., 73 figs., 29 tabs., 9 appendices.

6144 (INIS-BR–2991) **Electrolytic hydriding and hydride distribution in zircaloy-4.** Gomes, M.H.L. Minas Gerais Univ., Belo Horizonte, MG (Brazil). Dept. de Engenheria Metalurgica. 1974[70] (In Portuguese). Order Number DE93608799. Source: OSTI; NTIS (US Sales Only); INIS.

A study has been made of the electrolytic hydriding of zircaloy-4 in the range 20-80^0 C, for reaction times from 5 to 30 hours, and the effect of potential, pH and dissolved oxygen has been investigated. The hydriding reaction was more sensitive to time and temperature conditions than to the electrochemical variables. It has been shown that a controlled introduction of hydrides in zircaloy is feasible. Hydrides were found to be plate like shaped and distributed mainly along grain-boundaries. It has been shown that hydriding kinetics do not follow a simple law but may be described by a Johnson-Mehl empirical equation. On the basis of this equation an activation energy of 9.400 cal/mol has been determined, which is close to the activation energy for diffusion of hydrogen in the hydride. (author).

6145 (INIS-BR–3067) **Electrocatalytic oxidations of pyridine derivatives using Ru(IV) poly pyridine complex.** Oliveira, S.M. de. Sao Paulo Univ., Ribeirao Preto, SP (Brazil). Faculdade de Filosofia, Ciencias e Letras. 1989[72] (In Portuguese). Order Number DE93608800. Source: OSTI; NTIS (US Sales Only); INIS.

The oxidation reactions electro catalysed by bi pyridine oxo tri pyridine ruthenium perchlorate metallic complex from selected organic substrates are studied. The obtained results are compared with forecasting results showing the coherence of suggested mechanism. The substrates 2-, 2- and 4- picolines with its respective 1-oxides and 1,2 -; 1,3 - and 1,4 - dimethyl pyridine chloride salts were analysed. The oxidation of toluene as reference substrate was also studied and the mass spectra of oxidation products were interpreted. (M.C.K.).

6146 (INIS-mf–13386, pp. 389-401) **Voltammetric studies of uranium (VI) reduction.** Inamdar, G.A. (Bhabha Atomic Research Centre, Bombay (India). Fuel Reprocessing Div.); Dhaneshwar, R.G. Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences. 1991. [472] (CONF-8912172–: International symposium on uranium technology, Bombay (India), 13 Dec 1989). In *Proceedings of the international symposium on uranium technology [held at Bombay during 13-15 Dec 1989]. V. 1.* Order Number DE93608776. Source: OSTI; NTIS (US Sales Only); INIS.

Sufficient data are not available for the voltametric uranyl studies at different metal wire and metal amalgam wire electrodes. Uranyl reduction, therefore, was tried at gold wire as well as, gold amalgam wire indicator electrodes, employing the three electrode system where platinum wire electrode is auxiliary and molybdenum wire is reference electrode. The study was carried out in acidic neutral and alkaline media, and in buffered and unbuffered solution as well. The acidic medium at gold indicator electrode only a single curve was obtained in different acids and buffers. The highest current of 83 μamp is obtained in 0.1 M hydrochloric acid for 1.0 mM uranyl concentration. No disproportion of U(VI) could be detected at gold indicator electrode. However in contrast to acidic media, two peaks were obtained in 0.1 M each of potassium nitrate and potassium chloride medium, current concentration linearity being obtained for both peaks. The highest currents were obtained in 0.01 M potassium chloride, being 75 and 335 μamp respectively for 1.0 mM uranium concentration. Similar results were obtained at gold amalgam electrode though the current heights obtained in acidic media at the amalgam electrode are considerably smaller than those at gold electrode. In neutral media, the results obtained at gold electrode are comparable to the results obtained at amalgam electrode. Thus amalgam electrode does not behave as mercury electrode. Comparison of the results obtained for these three electrodes is discussed. (author). 7 refs., 1 fig s., 4 tabs.

6147 (INIS-mf–13387, pp. 939-946) **Uranyl Ion transport across tri-n-butyl phosphate/n-dodecane liquid membranes.** Shukla, J.P. (Bhabha Atomic Research Centre, Bombay (India). Radiochemistry Div.); Misra, S.K. Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences. 1991. [653] (CONF-8912172–: International symposium on uranium technology, Bombay (India), 13 Dec 1989). In *Proceedings of the international symposium on uranium technology [held at Bombay during 13-15 Dec 1989]. V. 2.* Order Number DE93608801. Source: OSTI; NTIS (US Sales Only); INIS.

Carrier-facilitated transport of uranium (VI) against its concentration gradient from aqueous nitrate acidic solutions across organic bulk liquid membranes (BLM) and supported liquid membranes (SLM) containing TBP as the mobile carrier and n-dodecane as the membrane solvent was investigated. Extremely dilute uranyl nitrate solutions in about 2.5 M nitric acid generally constituted as the source phase. Uranyl transport appreciably increased with both stirring of the receiving phase and the carrier concentration in the organic membrane, while enhanced acidity of the strip side adversely affected the partioning of the cation into this phase. Among the several reagents tested, diluted ammonium carbonate (≈1M) solutions served efficiently as the stripant. Besides Accurel polypropylene (PP) film as the solid support for SLM, some silicon flat-sheet membranes with different inorganic fillers like silica, calcium silicate, calcium carbonate, chromium oxide, zinc oxide etc. and teflon membranes transported about 70% of uranium in nearly 7-8 hr employing 1 M ammonium carbonate as the strippant. Specifically, 30% TBP supported on Accurel flat-sheet supports transfered better than 70% of uranium from moderate acid feeds (2.5M) under similar conditions. Membranes supporting Aliquat-336, TLA, TOPO etc. yielded somewhat poor uranium recoveries. The feed : strip volume ratio showed an inverse relationship to the fraction of cation transported. (author). 9 refs., 2 tab s.

6148 (IS-T–1632) **Organometallic and reactor studies of the thiophene hydrodesulfurization mechanism.** Benson, J.W. Ames Lab., IA (United States). 30 Oct 1992. 174p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-82. Order Number DE93004461. Source: OSTI; NTIS; GPO Dep.

This dissertation contains a general introduction and four papers. The introduction is a review of the mechanisms of thiophene hydrodesulfurization (HDS) as proposed in literature. The papers are: equilibrium studies of displacement of η^1(S)-thiophenes (T) from $Cp(CO)(PPh_3)Ru(\eta^1(S)\text{-}T)^+$; equilibrium and kinetic studies of S-coordinated T in $Cp(CO)_2Ru(\eta^1(S)\text{-}T)^+$ and $Cp(CO)(PPh_3)Ru(\eta^1(S)\text{-}T)^+$: models for T adsorption on HDS catalysts; reactions of 2- benzo[b]thienyl(2-BTyl) complexes with acid to give $Cp(PMe_3)_2Ru(\eta^1(S)\text{-}BT)^+$ and $Cp(CO)(PPh_3)Ru(\eta^1(S)\text{-}BT)^+$: a model for benzo[b]thiophene (BT) deuterium exchange on HDS catalysts; and studies of mechanism of T hydrodesulfuriztion: ^2H NMR and mass spectral analysis of 1,3- butadiene produced in the deuterodesulfurization of T over $PbMo_{6.2}S_8$ catalyst.

6149 (JINR-E–12-91-28) **Electrophoretic investigations of hydrolysis and formation of fluoride complexes of carrier-free ^{155}Eu.** Schumann, D.; Novgorodov, A.F.; Khalkin, V.A. Joint Inst.

for Nuclear Research, Dubna (Russian Federation). Lab. of Nuclear Problems. 1991. [6] Order Number DE93608802. Source: OSTI; NTIS (US Sales Only); INIS.

The processes of hydrolysis and formation of fluoride complexes of carrier-free $^{155}Eu(III)$ have been investigated by electromigration in aqueous solutions of $Na(H)ClO_4$ (μ=0.1, 25 deg C). The brutto hydrolysis constant $p\beta_{3h}$=25.5(5) and the stepwise stability constants of the EuF_n^{3-n} complexes $lg\beta_{1K}$=4.6(2), $lg\beta_{2K}$=1.16(4), $lg\beta_{3K}$=9.40(7) have been calculated on the basis of the experimental data. The influence of the competition between the processes of fluoride complex formation and hydrolysis on the europium mobility has been investigated. 6 refs.; 3 figs.

6150 (LA-UR-92-3260) **Hydrophobic effects from cavity statistics.** Pratt, L.R. (Los Alamos National Lab., NM (United States)); Pohorille, A. Los Alamos National Lab., NM (United States). [1992]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9206312-1: 1992 European Biophysical Society (EBSA) workshop on water on water-biomolecule interactions, Palermo (Italy), Jun 1992). Order Number DE93003698. Source: OSTI; NTIS; GPO Dep.

Given here is a simple introduction to the statistics characterizing spontaneous cavity formation in liquids. These statistical quantities provide helpful diagnostics of solvation in complex solutions and it is recommended that their estimation be generally implemented in simulation of biomolecule systems. Examples show that the most probable cavities which occur in liquid water are not smaller than those which form in n-hexane. However, the cavities which form in liquid water are constitute a narrower distribution than those in n-hexane or in a random medium of the same density. Even though these methods provide radial distributions of water near a hard sphere solute of high precision relative to more conventional calculations, still further theoretical treatment of the longer ranged behavior of these distributions will be required to extract fluctuation thermodynamic quantities such as the partial molar volume of the solute at infinite dilution.

6151 (LBL-32871) **High resolution photoelectron spectroscopy and femtosecond intramolecular dynamics using supersonic molecular beams.** Niu, B. Lawrence Berkeley Lab., CA (United States). Sep 1992. 192p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE93002555. Source: OSTI; NTIS; GPO Dep.

High resolution He Iα photoelectron spectroscopy of formaldehyde and ketene and their deuterated compounds, are reported. The combination of a (H2CO) double-pass high-resolution electron-energy analyzer and effective rotational cooling of the sample by supersonic expansion enable the spectroscopy of these molecular cations. The vibrational autocorrelation functions are calculated from the high-resolution photoelectron spectra, shedding light on the ultrafast intramolecular dynamics of the molecular cations. This study reveals much more vibrational structural detail in the first electronic excited state of H2CO cations. The first electronic excited state of H2CO cations may have nonplanar equilibrium geometry. Strong isotope effects on vibronic (vibrational) coupling are observed in the second electronic excited state of H2CO. Vibrational autocorrelation functions are calculated for all four observed electronic states of H2CO. The correlation function of the first electronic excited state of H2CO shows a slow decay rate on the femtosecond time scale. The ultrafast decay of the H2CO cations in the third electronic excited state implies that dissociation and intramolecular processes are the main decay pathways. The present spectra of the ground states of ketene cations have more fine structure than before. The AIEs of the first and fifth excited states are determined unambiguously more accurately. The doublet-like fine structures present in the lint excited state of ketene implies the excitation of a "soft" mode not observed before. The vibrational autocorrelation functions are calculated for 4 of the 6 observed electronic states. The dynamics of the ground states of the cations are characterized by a wave packet oscillating with small amplitude around the minimum on the upper PES. The decay dynamics of the first and the fifth excited states of ketene are characterized by ultra-fast intramolecular processes like predissociation.

6152 (NIPER-598) **The thermodynamic properties of 4,5,9,10-tetrahydropyrene and 1,2,3,6,7,8-hexahydropyrene.** Chirico, R.D.; Knipmeyer, S.E.; Nguyen, A.; Smith, N.K.; Steele, W.V. National Inst. for Petroleum and Energy Research, Bartlesville, OK (United States). Dec 1992. 64p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-83FE60149. Order Number DE93000102. Source: OSTI; NTIS; GPO Dep.

Measurements leading to the calculation of the ideal-gas thermodynamic properties are reported for 4,5,9,10-tetrahydropyrene and 1,2,3,6,7,8-hexahydropyrene. Experimental methods included combustion calorimetry, adiabatic heat-capacity calorimetry, vibrating-tube densitometry, comparative ebulliometry, inclined-piston gauge manometry, and differential-scanning calorimetry (d.s.c.). Critical properties were estimated for both materials based on the measurement results. Entropies, enthalpies, and Gibbs energies of formation were derived for the ideal gases for selected temperatures between 380 K and 700 K. The property-measurement results reported here for 4,5,9,10-tetrahydropyrene and 1,2,3,6,7,8-hexahydropyrene are the first for these important intermediates in the pyrene/H_2 hydrogenation reaction network.

6153 (NIPER-623) **Thermodynamic modeling for organic solid precipitation.** Chung, T.H. National Inst. for Petroleum and Energy Research, Bartlesville, OK (United States). Dec 1992. 29p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-83FE60149. Order Number DE93000104. Source: OSTI; NTIS; GPO Dep.

A generalized predictive model which is based on thermodynamic principle for solid-liquid phase equilibrium has been developed for organic solid precipitation. The model takes into account the effects of temperature, composition, and activity coefficient on the solubility of wax and asphaltenes in organic solutions. The solid-liquid equilibrium K-value is expressed as a function of the heat of melting, melting point temperature, solubility parameter, and the molar volume of each component in the solution. All these parameters have been correlated with molecular weight. Thus, the model can be applied to crude oil systems. The model has been tested with experimental data for wax formation and asphaltene precipitation. The predicted wax appearance temperature is very close to the measured temperature. The model not only can match the measured asphaltene solubility data but also can be used to predict the solubility of asphaltene in organic solvents or crude oils. The model assumes that asphaltenes are dissolved in oil in a true liquid state, not in colloidal suspension, and the precipitation-dissolution process is reversible by changing thermodynamic conditions. The model is thermodynamically consistent and has no ambiguous assumptions.

6154 (TVA/NFERC-91/4) **Crystallographic properties of fertilizer compounds.** Frazier, A.W.; Dillard, E.F.; Thrasher, R.D.; Waerstad, K.R.; Hunter, S.R.; Kohler, J.J.; Scheib, R.M. National Fertilizer and Environmental Research Center, Muscle Shoals, AL (United States). Feb 1991. 978p. Sponsored by Tennessee Valley Authority, Knoxville, TN (United States). (TVA-Bull-Y-217). Order Number DE93003931. Source: OSTI; NTIS.

This bulletin is a compilation of crystallographic data collected at NFERC on 450 fertilizer-related compounds. In TVA's fertilizer R and D program, petrographic examination, XRD, and infrared spectroscopy are combined with conventional chemical analysis methods in identifying the individual compounds that occur in fertilizer materials. This handbook brings together the results of these characterization studies and supplemental crystallographic data from the literature. It is in one-compound-per-page, loose-leaf format, ordered alphabetically by IUPAC name. Indexes provided include IUPAC name, formula, group, alternate formula, synonyms, x-ray data, optical data. Tables are given for solids, compounds in commercial MAP and DAP, and matrix materials in phosphate rock.

6155 (UCRL-53943-91, pp. 14-15) **Surface reactions induced and measured by scanning probe microscopy.** Balooch, M.; Siekhaus, W.J.; Tench, R.J. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990-1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

The authors have used scanning tunneling microscopy (STM) to investigate the kinetics of surface reactions that occur at individual

reaction sites. Specifically, they studied the gasification of graphite by oxygen and hydrogen over a wide range of conditions, including variations in temperature, reactant pressure, and exposure time. The authors also succeeded in enhancing the graphite-ozone reaction at specific sites. In separate experiments, they used atomic force microscopy (AFM) to study polymer coatings on inertial confinement fusion (ICF) spheres, starting with nucleation and proceeding through the growth process to the final product.

6156 (UCRL–53943-91, pp. 22-25) **First-principles approach to alloy phase stability.** Turchi, P.E.A.; Sluiter, M. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

The study of phase stability, including order-disorder phenomena and structural transformations, in substitutional alloys is of great theoretical and technological interest. This approach combines accurate quantum-mechanical and statistical descriptions of the configurational part of the total free energy of an alloy. The authors have successfully illustrated the interplay between electronic-structure properties, crystalline effects, and configurational order at the microscopic level for copper-zinc, iron-chromium, and iron-vanadium alloys, thus demonstrating the validity and the predictive power of this advanced methodology.

6157 (UCRL–53943-91, pp. 26-28) **A first-principles study of phase stability in nickel-aluminum alloys.** Sluiter, M.; Turchi, P.E.A. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

The authors have studied the thermodynamic stability of bcc- and fcc-based ordered phases in nickel-aluminum alloys with a highly accurate first-principles electronic-structure method. They can now predict the correct ground states, explain the solid solubility (or the lack thereof) in the terminal solid solutions, predict the occurrence of a martensitic transformation in a narrow composition range, and relate it to the competition between bcc- and fcc-based ordered structures. The authors computed the nickel-rich portion of the phase diagram, and the excellent agreement of these calculations with experimental determinations confirms the accuracy of this present approach.

6158 (UCRL–53943-91, pp. 78-80) **LEED determination of multilayer relaxation in stepped surfaces.** Gonis, A. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

The real-space multiple scattering theory (RSMST), combined with an automated tensor low-energy electron diffraction (LEED) method, is used to determine atomic relaxations in the stepped platinum(210) surface for which conventional mechanisms fail. These relaxations are found to be primarily perpendicular to the surface and nonalternating in sign. Also, they are in good qualitative agreement with new results from using the embedded-atom method.

6159 (UCRL–53943-91, pp. 81-83) **Experimental and theoretical determination of the atomic structure of the (310) twin in niobium.** Foiles, S.M. (Sandia National Lab., Livermore, CA (United States)); Gumbsch, P.; Ruehle, M.; Campbell, G.H.; King, W.E. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

The authors fabricated a (310) twin boundary in niobium by diffusion-bonding oriented single crystals, characterized it using high-resolution electron microscopy, and predicted the atomic structures for the boundary using different interatomic potentials. After comparing the theoretical models to the high-resolution images by image simulation, the authors have ruled out one of the low-energy structures predicted by theory.

6160 (UCRL–53943-91, pp. 84-86) **The real-space multiple-scattering theory and the electronic structure of grain boundaries.** Sowa, E.C.; Gonis, A. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

The authors have used the real-space multiple-scattering theory (RSMST) to perform non-charge-self-consistent electronic-charge calculations on the Σ5 (310) tilt grain boundary in copper and on the Σ5 (100) 36.9° twist grain boundary in copper and niobium. These calculations show the effect of the atomic environment on the local density of electronic states near the grain boundary. The authors have begun work on a charge-self-consistent version of the method that will be able to calculate total energies.

6161 (UCRL–53943-91, pp. 90-92) **Thermal stability of Mo/Si multilayers.** Rosen, R.S. (Lawrence Livermore National Lab., CA (United States)); Stearns, D.G.; Viliardos, M.A.; Kassner, M.E.; Vernon, S.P. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

By means of annealing studies at relatively low temperatures for various times, the authors investigated the thermal stability of Mo/Si multilayers. They found two distinct stages of thermally activated interlayer growth: a primary surge, followed by a (slower) secondary steady-state growth where the interdiffusion coefficient is constant. The interdiffusion coefficients for the interlayer formed by deposition of Mo on Si are 200 times greater than those of the interlayer formed by deposition of Si on Mo. The interdiffusion coefficient and apparent activation energy for the secondary stage of Mo-on-Si interlayer growth are comparable to values for diffusion of silicon in hexagonal $MoSi_2$.

6162 (UCRL–53943-91, pp. 99-101) **Quasiparticles in doped La_2CuO_4.** Grant, J.B. (Lawrence Livermore National Lab., CA (United States)); McMahan, A.K. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

The authors have carried out limited-configuration interaction calculations for a chemically realistic, eight-band, effective Hamiltonian for La_2CuO_4. The resultant quasiparticle dispersion curves agree with available experimental data. These results suggest that the first holes doped into La_2CuO_4 are of predominant oxygen $2p_{sigma}$ character, have momentum $k = (1/2, 1/2, 0)\pi/a$ and have spins that are continually flipping as a result of spin exchange with the intrinsic copper spins, at a rate characterized by $J_{pd} \sim 0.33$ eV. The copper $3d_{3z^2-r^2}$ and apical oxygen $2p_z$ states are crucial to the quasiparticle dispersion.

6163 (UCRL–53943-91, pp. 105-107) **Photoelectron studies of in situ cleaved crystals of $YBa_2Cu_3O_7$.** Colmenares, C. (Univ. of California, Davis (United States)); Liu, J.Z.; Evans, C.; Smith, R.L. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

The authors have used x-ray and ultraviolet photoelectron spectroscopies (XPS and UPS) to study the near-surface chemistry of $YBa_2Cu_3O_{7-x}$ (YBCO) single crystals cleaved in ultrahigh vacuum (UHV) at 300 K. Oxygen loss from this material was not detectable under these conditions with the instrumentation used. Core-level and valence-band measurements showed that YBCO decomposed rapidly when irradiated by x-rays and ultraviolet light. Also, exposure of freshly cleaved YBCO surfaces to atmospheric air reduced the oxidation state of copper from Cu^{+2} to Cu^{+1}, while the yttrium and barium components formed oxides, hydroxides, and carbonates.

6164 (UCRL–53943-91, pp. 108-111) **The valence bands and Fermiology of untwinned, single-crystal $YBa_2Cu_3O_{6.9}$.** Olson, C.G. (Ames Lab., IA (United States)); Gu, C.; Liu, J.Z.; Tobin, J.G.; Solal, F.R.; Fluss, M.J.; Howell, R.H.; O'Brien, J.C.; Radousky, H.B.; Sterne, P.A. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

The authors probed the cleaved surfaces of untwinned, single-crystal $YBa_2Cu_3O_{6.9}$ (YBCO) with photoemission induced by

synchrotron radiation, using high-energy and high-angular resolution. They observed acute spectral structure, both at the Fermi energy and at higher binding energies, particularly near the high-symmetry points of the two-dimensional Brillouin zone (e.g., $\bar{\Gamma}$, $\bar{X}$, $\bar{Y}$, and $\bar{S}$). This data is consistent with a superconducting gap of less than 10 meV.

6165 (UCRL–53943-91, pp. 170-172) **Applications of ultrashort-pulse laser technology to materials characterization and investigations of condensed-phase energy-transfer dynamics.** Ruggiero, A.J. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

New high-repetition-rate, high-power, femtosecond-pulse laser technology is being implemented in the study of condensed-phase energy-transfer dynamics. Uses of the new system include (1) precise determination of vibrational lifetimes and dephasing rates in energetic materials and (2) studies of phonon-mediated energy-transfer dynamics in aerogels.

4004 Electrochemistry

Refer also to citation(s) 5832, 5978, 6004, 6006, 6058

6166 (UCRL–53943-91, pp. 152-154) **Preparation of solid-membrane ion-selective electrodes by ion implantation.** Glass, R.S.; Musket, R.G.; Hong, K.C. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

Ion implantation has been used to prepare solid-membrane ion-selective sensors. For example, a thin AgCl membrane (typically about 100 nm thick) is created by bombarding a silver substrate with 33- to 200-keV $^{35}Cl^{+}$. These surface-modified substrates act as sensors for chloride ion in solution over a concentration range of several decades and have rapid response times. The authors believe that ion implantation will prove to be a general method for fabricating a variety of ion-selective sensors that will have well-controlled properties.

4005 Photochemistry

Refer also to citation(s) 6094, 6163, 6172, 6173, 6174, 6484, 6485, 6513

6167 (DOE/ER/13504–7) **Photoinduced electron transfer processes in homogeneous and microheterogeneous solutions: Progress report, April 16, 1992–December 1, 1992.** Whitten, D.G. Rochester Univ., NY (United States). Dec 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-86ER13504. Order Number DE93005329. Source: OSTI; NTIS; GPO Dep.

The studies have focused on rapid, efficient bond-fragmentation reactions initiated through photoinduced electron transfer. Electron transfer induced fragmentation of a number of donors have been examined, especially 1,2 diamines and related compounds. Two of the amines fragment with rate constants of 3×10^8 to 2×10^9 $M^{-1}sec^{-1}$. A series of amino-substituted pinacols and related compounds have also been examined; they undergo similar but slower fragmentation processes when converted to their cation radicals by photoinduced electron transfer. The studies with linked and polymeric electron donor- electron acceptor coupled molecules have also progressed. Several polymers containing diamine repeat units and anthraquinone or nitroaromatic acceptors have also been prepared that can be photoactivated by visible irradiation; they fragment efficiently in solution and photodegrade even in the solid state. The studies of singlet oxygen initiated fragmentation reactions of diamines, amino alcohols, and aminoketones have nearly been completed. Attention have been turned to fragmentable electron acceptors such as p- cyanobenzyl bromide; irradiation of electron donors such as methyl- or methoxy-naphthalenes can initiate efficient fragmentation of the electron deficient bromide.

6168 (DOE/ER/13766–10) **Reactions of metal ions and their clusters in the gas phase using laser ionization: Fourier transform mass spectrometry: Progress report, February 1, 1992–January 31, 1993.** Freiser, B.S. Purdue Univ., Lafayette, IN (United States). Dept. of Chemistry. Nov 1992. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-87ER13766. Order Number DE93006505. Source: OSTI; NTIS; GPO Dep.

This report focuses on three areas we have made substantial new progress in over the past several months: (1) Infrared multiphoton photoinduced ion molecule reactions; (2) The use of SF_6 to detect excited state metal ion behavior; and (3) Cluster ion chemistry.

6169 (DOE/ER/14105–3) **Photoinduced electron transfer reactions in zeolite cages: Progress report, January 15, 1990–August 1, 1992.** Dutta, P.K. Ohio State Univ., Columbus, OH (United States). Dept. of Chemistry. [1992]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER14105. Order Number DE93005928. Source: OSTI; NTIS; GPO Dep.

This report summarizes work in the two areas of zeolites and layered double hydroxides. Results of studies on structural aspects of $Ru(bpy)_3^{2+}$-zeolite Y are summarized. Photoinduced electron transfer between entrapped $Ru(bpy)_3^{2+}$ and methylviologen (MV) in neighboring supercages was examined. Benzylviologen was also used. Since molecules larger than 13 Å cannot be accomodated in zeolite cages, the layered double metal hydroxides (LDH) $LiAl_2(OH)_6^{+}X^{-}$ is being investigated. Organized assemblies of hydrophobic domains are made by introducing into the interlayer long-chain carboxylic acids $R(CH_2)_nCOOH$. Zinc tetraphenylporphyrin sulfonate (ZnTPPS) is introduced into myristate-LiAl-LDH; photolysis of ZnTPPS-AiAl-LDH with MV^{2+} in solution was examined.

6170 (UCRL–53943-91, pp. 87-89) **Laser-induced desorption of aluminum from $Al_2O_3(11\bar{2}0)$.** Schildbach, M.A.; Hamza, A.V. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

The authors investigated the laser-induced desorption of particles from a well-characterized sapphire ($11\bar{2}0$) surface at laser wavelengths of 1064 nm (1.17 eV) and 355 nm (3.51 eV). Below the laser ablation threshold, only aluminum ions desorbed, with average kinetic energies of 7.0 ± 0.7 eV at both photon energies. These high kinetic energies indicate an electronic desorption mechanism. Upon heating to over 1600K, the surface reconstructed, exhibiting a (12 × 4) low-energy electron diffraction pattern. The electron energy-loss spectrum for this surface, with a broad (~2 eV FWHM) loss feature centered at 3.6 eV, revealed surface electronic states in the bulk band gap of sapphire. The authors believe that the surface electronic states participate in the photon absorption process.

6171 (UCRL–53943-91, pp. 159-160) **Determination of absolute transition probabilities in neutral cerium.** Bisson, S.E. (Lawrence Livermore National Lab., CA (United States)); Worden, E.F.; Comaskey, B.; Conway, J.G. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

The authors used a 1-m Fourier transform spectrometer to obtain the cerium emission spectrum from an electrodeless discharge lamp. Branching ratios from the intensity data, combined with upper-level lifetimes measured by laser techniques, yielded weighted Einstein A values (gA values) for 30 transitions. A plot of the natural logarithm of intensity divided by gA as a function of upper-level energy gives the source excitation temperature and gA values for all lines of neutral cerium with known upper level.

4006 Radiation Chemistry

Refer also to citation(s) 5400

6172 (ANL/CHM/CP–75982) **Early events following radiolytic and photogeneration of radical cations in hydrocarbons.**

Werst, D.W.; Trifunac, A.D. Argonne National Lab., IL (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9204138–8: International conference of radiation-tolerant scintillators and detectors, Tallahassee, FL (United States), 28 Apr - 2 may 1992). Order Number DE93003010. Source: OSTI; NTIS; INIS; GPO Dep.

Real-time studies in hydrocarbons have revealed a richness of chemistry involving the initial ionic species produced in radiolysis and photoionization. A modified radical cation mechanism patterned after the core mechanism for alkane radiolysis-formation of radical cations and their disappearance via ion-molecule reactions - is capable of explaining a wide range of observations in high-energy photochemistry, and thus unifies two high-energy regimes. Fundamental studies of radical cations suggest strategies for mitigating radiation effects in materials.

6173 (ANL/CP–76176) **Early events in radiation chemistry and in photoionization.** Trifunac, A.D.; Loffredo, D.M.; Liu, A.-D. Argonne National Lab., IL (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-920909–1: 8. international meeting on radiation processing, Beijing (China), 14-19 Sep 1992). Order Number DE93002991. Source: OSTI; NTIS; INIS; GPO Dep.

Real-time studies of aliphatic and aromatic hydrocarbons by pulse radiolysis and laser photoionization reveal the chemistry of the ionic species in the condensed phase. The occurrence of radical cation reactions with solvent molecules provides the core mechanism capable of explaining a wide range of observations in photoionization and radiation chemistry. The study of products and transients in photoionization of aromatic solutes in hydrocarbon and alcohol solvent illustrates several details of this "high-energy" chemistry. A reaction pathway involving ion-molecule reaction of excited ions is indicated for a series of polycyclic aromatic hydrocarbons photoionized using intense excimer laser (248 and 308 nm) pulses in hydrocarbon and alcohol solutions. We have found that condensed-phase ion-molecule reactions in radiolysis are ubiquitous and we speculate on their overall role in hydrocarbon radiolysis.

6174 (ANL/RPG–93/1) **Radiation and Photochemistry Section annual report, October 1991–September 1992.** Argonne National Lab., IL (United States). Nov 1992. 44p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93004737. Source: OSTI; NTIS; INIS; GPO Dep.

A survey is presented of research on reactive intermediates in the condensed phase and chemistry induced by energetic radiation. The survey is presented in two major parts: (1) ions, excited states, and other transients in condensed phase; and (2) role of solvents in chemical reactivity. Accelerator activities (20-MeV linac, 3-MeV Van de Graaff) are summarized.

6175 (INIS-BR–3105) **Crystallinity modification induced in poly(phenylene sulfide) (PPS) films by ion irradiation.** Rizzatti, M.R. (Rio Grande do Sul Univ., Porto Alegre, RS (Brazil). Inst. de Fisica); Papaleo, R.M.; Livi, R.P.; Araujo, M.A. de. Associacao Brasileira de Polimeros, Sao Paulo, SP (Brazil). 1991[5] (CONF-9111280–: 1. Brazilian Congress on Polymers, Sao Paulo (Brazil), 5-7 Nov 1991). Order Number DE93608909. Source: OSTI; NTIS (US Sales Only); INIS.

Thin PPS films (2_{10} μ thick) were bombarded with energetic $^{1}H^{+}$ (300 KeV), $^{4}He^{+}$ (380 KeV), $^{10}B^{+}$ (350 KeV) and $^{40}Ar^{++}$ (700 KeV) ions, with fluences ranging from 10^{12} to 8×10^{14} ions/cm^2. The beam current density was 20 n A/cm^2 in order to avoid sample heating. The modified samples were analysed by differential scanning calorimetry (DSC) and X-ray diffractometry. (author).

6176 (INIS-BR–3106) **Dependence of crystallinity degree with induced grafting by gamma radiation of N,N'-dimethyl acrylamide.** Queiroz, A.A.A. (Instituto de Pesquisas Energeticas e Nucleares (IPEN), Sao Paulo, SP (Brazil)); Higa, O.Z.; Barrak, E.R.; Giolito, I. Associacao Brasileira de Polimeros, Sao Paulo, SP (Brazil). 1991[3] (In Portuguese). (CONF-9111280–: 1. Brazilian Congress on Polymers, Sao Paulo (Brazil), 5-7 Nov 1991). Order Number DE93608910. Source: OSTI; NTIS (US Sales Only); INIS.

N,N' -dimethyl acrylamide (DMAA) graft copolymerization onto polyethylene films was carried out, using a organic solvent as a reaction medium and gamma rays from a ^{60} Co source for surface activation. Thermal analysis revealed the crystallinity and the grafting inversely proportional. The DSC curves fusion peaks decreased with grafting rate increase, the peak almost disappearing in the curve of PE 440% grafted. It was concluded that the graft occurs not only on the surface but also in the substrate bulk, being the PE absorption of DMAA an important factor for build up of grafted mass. (author).

6177 (INIS-BR–3107) **Gamma irradiation effect over additive polypropylene.** Bettini, S.H.P. (Universidade Estadual de Campinas, SP (Brazil). Fac. de Engenharia Quimica); Bittencourt, E. Associacao Brasileira de Polimeros, Sao Paulo, SP (Brazil). 1991[6] (In Portuguese). (CONF-9111280–: 1. Brazilian Congress on Polymers, Sao Paulo (Brazil), 5-7 Nov 1991). Order Number DE93608911. Source: OSTI; NTIS (US Sales Only); INIS.

The effect of stabilizing additives such as inhibitors of radical propagation and blends with amorphous polymers is investigated. (author).

6178 (INIS-BR–3109) **Grafting of n-vinyl-2-pyrrolidone over polyethylene by gamma irradiation: preparation and characterization.** Queiroz, A.A.A. (Instituto de Pesquisas Energeticas e Nucleares (IPEN), Sao Paulo, SP (Brazil)); Higa, O.Z. Associacao Brasileira de Polimeros, Sao Paulo, SP (Brazil). 1991[2] (In Portuguese). (CONF-9111280–: 1. Brazilian Congress on Polymers, Sao Paulo (Brazil), 5-7 Nov 1991). Order Number DE93608912. Source: OSTI; NTIS (US Sales Only); INIS.

Some parameters for the preparation of low density polyethylene films (LDPE) grafted with N-Vinyl-2-pirrolodona (NVP) by the simultaneous irradiation method were determined. The concentration of NVP for a grafting degree of 69% (maximum) was 60% (v/v), at a irradiation dose of 0,823 KGy at 27^{0} C. Infrared spectroscopic measurements of the grafted LDPE films showed the appearance of characteristic bands of the NVP structure. (author).

6179 (INIS-BR–3111) **Morphological changes in Ion beams irradiated polyethylene terephthalate (PET).** Papaleo, R.M. (Rio Grande do Sul Univ., Porto Alegre, RS (Brazil). Inst. de Fisica); Rizzatti, M.R.; Livi, R.P.; Araujo, M.A. de. Associacao Brasileira de Polimeros, Sao Paulo, SP (Brazil). 1991[6] (CONF-9111280–: 1. Brazilian Congress on Polymers, Sao Paulo (Brazil), 5-7 Nov 1991). Order Number DE93608913. Source: OSTI; NTIS (US Sales Only); INIS.

Thin PET foils were bombarded by $^{1}H^{+}$, $^{4}He^{+}$, $^{20}Ne^{++}$ and $^{40}Ar^{++}$ ions. The beam induced modifications as a function of irradiation fluence, were studied by DSC, FTIR and X-ray diffractometry. The pronounced modification of the implanted samples thermal behavior was associated with changes in the crystallite morphology, and with an increase in the polymer disordered regions. (author).

4007 Radiochemistry and Nuclear Chemistry

Refer also to citation(s) 5597, 6149, 6642

6180 (ANL/CHM/CP–77717) **Physisorption of deuterium on deuterated nickel clusters.** Zhu, L.; Ho, J.; Parks, E.K.; Riley, S.J. Argonne National Lab., IL (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-920921–6: 6. international symposium on small particles and inorganic clusters, Chicago, IL (United States), 16-22 Sep 1992). Order Number DE93003007. Source: OSTI; NTIS; GPO Dep.

Physisorption of deuterium molecules on small nickel clusters already saturated with chemisorbed deuterium atoms is identified. The principal evidence for physisorption is the appearance at reaction temperatures below 200 K of product species having more deuterium bound to them than the chemisorption maximum, and a lowering of cluster ionization potentials (IPs) for these species. It is argued that the IP lowering is a consequence of molecular physisorption, and that identification of the number of physisorption sites on cluster surfaces can be used to infer structural information.

6181 (BNL–48081) **Iodine-124 production: Excitation function for the $^{124}Te(d,2n)^{124}I$ and $^{124}Te(d,3n)^{123}I$ reactions from 7 to 24 MeV.** Firouzbakht, M.L.; Schlyer, D.J.; Finn, R.D.; Wolf, A.P. Brookhaven National Lab., Upton, NY (United States). [1992]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-921116–9: 12. international conference on the application of accelerators in research and industry, Denton, TX (United States), 2-5 Nov 1992). Order Number DE93002949. Source: OSTI; NTIS; GPO Dep.

The excitation function for the production of I-124 and I-123 from deuterons on teliurium-124 has been measured over the energy interval of 7.5 to 23.6 MeV. The target used was a compressed tellurium powder target. The thick target yields for both radioisotopes have been calculated, radiochemical purity was determined and recovery of the isotopically enriched tellurium has been investigated.

6182 (GSF–4/92, pp. 63) **Production of ^{43}K and $^{16,\ 82m,\ 83,\ 84}Rb$ isotopes at the Debrecen cyclotron for ecological purposes.** Fenyvesi, A. (Hungarian Academy of Sciences, Debrecen (Hungary). Inst. of Nuclear Research); Tarkanyi, F.; Mahunka, I.; Szelecsenyi, F.; Szuecs, Z.; Molnar, T.; Beres, C. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany). Inst. fuer Oekologische Chemie. 1992. (CONF-9104400–: International symposium on ecological approaches of environmental chemicals, Debrecen (Hungary), 15-17 Apr 1991). In *Ecological approaches of environmental chemicals. Proceedings.* 443p. Order Number DE93750725. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. POTASSIUM 43/isotope production; RUBIDIUM 81/isotope production; RUBIDIUM 83/isotope production; RUBIDIUM 82/isotope production; RUBIDIUM 84/isotope production; HUNGARY/debrecen cyclotron; HUNGARY; ECOSYSTEMS; RADIONUCLIDE MIGRATION

6183 (IEN–39/92) **Charged particle radioisotope production at Instituto de Engenharia Nuclear - IEN.** Lemos Junior, O.F. Instituto de Engenharia Nuclear (IEN), Rio de Janeiro, RJ (Brazil). May 1992. [41] (In Portuguese). Order Number DE93608881. Source: OSTI; NTIS (US Sales Only); INIS.

A variable energy isochronous cyclotron (CV-28) was installed in 1974 at the Instituto de Engenharia Nuclear in Rio de Janeiro, with the purpose, among others, of irradiating suitable targets to produce radioisotopes for medical diagnostic studies. This papers is an overview of the work done in the last two decades and reports the present status on the production of iodine-123 and gallium-67. (author).

6184 (INIS-BR–3062) **Production of ^{123} I for medical diagnosis application.** Britto, J.L.Q. de. Universidade Federal, Rio de Janeiro, RJ (Brazil). Coordenacao dos Programas de Posgraduacao de Engenharia. 1982[56] (In Portuguese). Order Number DE93608882. Source: OSTI; NTIS (US Sales Only); INIS.

A method for production of carrier free ^{123} I with high radionuclidic purity in which the processing is done remotely was developed at Instituto de Engenharia Nuclear in Rio de Janeiro. The ^{123} I is produced in the decay of ^{123} Xe which is obtained through the reaction ^{122} Te (^{3} He, 2 n) ^{123} Xe with 30 MeV ^{3} He beams of IEN's variable energy cyclotron. The irradiated natural Te O_2 target is heated in a furnace at 675^0 C and the diffused out ^{123} Xe is adsorbed in a copper trap maintained at -196^0 C. The ^{123} Xe is allowed to decay during 6.3 hours and the ^{123} I produced washed out of the trap with a 0.1 N solution of NaOH. All the process is remotely controlled by using electric and pneumatic systems as well as manipulators and tongs. The quality control was achieved by atomic absorption and gamma-ray spectroscopy. (author).

6185 (RFP–4628) **Application of surrogate materials in process study of actinides.** Raraz, A. (Colorado School of Mines, Golden, CO (United States). Kroll Inst. for Extractive Metallurgy); Mishra, B.; Averill, W.A. EG and G Rocky Flats, Inc., Golden, CO (United States). Rocky Flats Plant. [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC34-90DP62349. (CONF-930202–1: Annual meeting of The Metallurgical Society, Denver, CO (United States), 21-25 Feb 1993). Order Number DE93002257. Source: OSTI; NTIS; INIS; GPO Dep.

Measurement of process parameters in reactive metals processing, such as actinides, is extremely difficult due to dynamic nature of system operating at high temperatures and under protective atmospheres. In addition, performing studies with radioactive strategic metals is, generally, prohibitively expensive with significant safety concerns. This study discusses the use of cerium metal to simulate the pyrometallurgical characteristics of plutonium. Design parameters relating to ceramic component arrangement, process parameters relating to electrolyte behavior and operating parameters relating to cell temperature, anode stirring speed, current density and back emf for electrorefining have been studied. Molten tin, gallium, iodine and antimony-cadmium alloy have also been used to study the different parameters involved. Validity and justification of these measurements has been discussed.

6186 (UCRL–53943-91, pp. 178-179) **Glenn T. Seaborg Institute for Transactinium Science.** Sugihara, T.T. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

LLNL has organized a new institute that will focus its activities on the science and technology of the transactinium elements. One of its major purposes is to educate and train new scientists in this field.

4008 Combustion, Pyrolysis, and High-Temperature Chemistry

Refer also to citation(s) 5170, 5806, 5869, 6125, 6253

6187 (DOE/CE/90213–T6) **Particulate and droplet diagnostics in spray combustion: Annual report.** Semerjian, H.G.; Presser, C. National Inst. of Standards and Technology, Gaithersburg, MD (United States). Chemical Process Metrology Div. Apr 1990. 58p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI01-86CE90213. Order Number DE93003632. Source: OSTI; NTIS; GPO Dep.

During the past year, significant progress was made in three different areas: measurement of droplet velocity distributions, applications of the polarization ratio sizing technique, and studies of fuel property effects on spray flame structure. Droplet velocity distributions were obtained with a single-component laser velocimetry system to obtain detailed information on the transport of individual droplets. The polarization ratio technique is being developed to obtain instantaneous droplet sizes in nonburning and burning sprays. Droplet size and velocity measurements were obtained with phase/Doppler interferometry for four different fuels to ascertain the influence of physical properties of fuels on the size, number density and velocity of droplets found in spray flames.

6188 (DOE/CE/90213–T7) **Particulate and droplet diagnostics in spray combustion: Annual report.** Semerjian, H.G.; Presser, C. National Inst. of Standards and Technology, Gaithersburg, MD (United States). Process Measurements Div. Sep 1991. 58p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI01-86CE90213. Order Number DE93003631. Source: OSTI; NTIS; GPO Dep.

During the past year, significant progress was made in four different areas: (a) measurement of droplet velocity distributions and time of arrival, (b) time-resolved measurement of droplet size with the ESPR technique, (c) study of the structure of methanol/dodecanol spray flames, and (d) comparison of droplet sizing techniques. Droplet velocity distributions and time of arrival were obtained with a single-component laser velocimetry system to obtain detailed information on the transport of individual droplets. The polarization ratio technique is being developed to obtain time resolved droplet sizes and number density in nonburning sprays. Droplet size and velocity measurements were obtained with phase/Doppler interferometry for different mixtures of methanol and dodecanol to ascertain evidence of the occurrence of microexplosions in this two-component fueled spray flame. Finally, a comparative analysis of droplet-size and number density was carried out in a pressure-atomized spray using three droplet sizing techniques (i.e., ESPR, PDI and LID).

6189 (DOE/ER/14053–T3) **Combustion-related studies using weakly-bonded complexes: Three year progress report.** Beaudet, R.A. University of Southern California, Los Angeles, CA (United States). Dept. of Chemistry. Mar 1992. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-89ER14053. Order Number DE93005250. Source: OSTI; NTIS; GPO Dep.

This research program is concerned with microscopic-level phenomena important in combustion; weakly bonded adducts formed in supersonic expansions are studied spectroscopically and used to limit the angles and impact parameters of bimolecular encounters. Species in which a free radical such as atomic oxygen is bonded to a stable molecule in a shallow well outside the reaction barrier. Tunable diode laser IR absorption spectroscopy is used to study the complexes of interest.

6190 (DOE/ER/14128–2) **Reaction and diffusion in turbulent combustion: Progress report.** Pope, S.B. Cornell Univ., Ithaca, NY (United States). 2 Oct 1992. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER14128. Order Number DE93006185. Source: OSTI; NTIS; GPO Dep.

Progress was made on the following: Development of two-variable (ξ - y) thermochemistry suitable for DNS (direct numerical simulation) studies; determination of laminar flame properties based on this thermochemistry; determination of the parameter range that can be accessed by DNS with good resolution; implementation of the thermochemistry in the DNS code; performance of exploratory simulations, and the development of techniques of relating Eulerian DNS data to turbulent combustion theories; implementation of the DNS code on parallel and distributed computers, and the study of relative molecular motion in turbulence.

6191 (LBL–32926) **Lewis number effects on turbulent premixed flame structure.** Goix, P.J. (Centre National de la Recherche Scientifique (CNRS), 230 - Mont-Saint-Aignan (France). URA CORIA); Shepherd, I.G. Lawrence Berkeley Lab., CA (United States). Sep 1992. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-9210213–3: 1992 Combustion Institute fall meeting of the western states section, Berkeley, CA (United States), 12-13 Oct 1992). Order Number DE93002571. Source: OSTI; NTIS; GPO Dep.

The influence of the Lewis number on turbulent flame front geometry is investigated in a premixed turbulent stagnation point flame. A laser tomography technique is used to obtain the flame shape, a fractal analysis of the multiscale flame edges is performed and the distribution of local flame front curvature is determined. Lean H_2/Air and C_3H_8/Air mixtures with similar burning rates were investigated with Lewis numbers of 0.33 and 1.85 respectively. At the conditions studied the laminar H_2/Air mixture is unstable and a cellular structure is observed. Turbulence in the reactant is generated by a perforated plate and the turbulent length scale (3mm) and intensity (7%) at the nozzle exit are fixed. The equivalence ratio is set so that the burning velocity is the same for all the cases. Results show clearly that the turbulent flame surface area is dependent on the Lewis number. For a Lewis number less than unity surface area production is observed. The shape of the flame front curvature distribution is not found to be very sensitive to the Lewis number. For the H_2/Air mixture the distribution is skewed toward the positive values indicating the presence of cusps while for the C_3H_8/Air mixture the distribution is more symmetrical. In both cases the average curvature is found to be zero, and if the local burning speed varies linearly with curvature, the local positive and negative burning velocity variations due to curvature will balance.

6192 (LBL–32928) **Experimental study of unsteady laminar and turbulent flame propagation in an enclosure by Rayleigh scattering.** Tamai, R. (Consiglio Nazionale della Ricerche, Naples (Italy). Ist. Motori); Shepherd, I.G.; Cheng, R.K. Lawrence Berkeley Lab., CA (United States). Sep 1992. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-9210213–4: 1992 Combustion Institute fall meeting of the western states section, Berkeley, CA (United States), 12-13 Oct 1992). Order Number DE93002570. Source: OSTI; NTIS; GPO Dep.

The Rayleigh scattering technique has been used to investigate the flame structure of unsteady propane/air flames propagating under quiescent and turbulent conditions initiated by three ignition methods: (1) conventional spark plug (2) pulse jet combustion (PJC) and (3) Pre-Chamber ignition (PCI). The Rayleigh signal obtained for the laminar cases are all characterized by a sharp transition associated with the large density change which occurs as leading flame front of the expanding flame kernel crosses the measurement point. This indicates that the local flame structures are independent of the ignition source and may be characterized as flamelets. The maximum burning rates deduced from the pressure records show that PJC and PCI increases the burning rate from two to three times above that of conventional spark ignition. The Rayleigh scattering signal obtained for the turbulent cases are also characterized by sharp transition. The wrinkled laminar flamelet model, therefore, provides a valid description of the flame structures for all these unsteady flames. For a given equivalence ratio, the maximum turbulent burning rate deduced for the three turbulent cases with different ignition sources are similar. This suggests that while PJC and PCI enhances burning rate when conditions in the chamber are quiescent, the enhancement is not significant when turbulence fluctuations are present. The PJC and PCI, however, are capable of igniting leaner conditions than the spark plug. This may be due to the injection process which initially disperses ignition sites to a larger volume at a faster rate.

6193 (SAND–93-8402C) **Inverse Raman spectroscopy measurements of line-shift coefficients in hydrogen perturbed by argon.** Forsman, J.W.; Farrow, R.L.; Rahn, L.A. Sandia National Labs., Livermore, CA (United States). [1993]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DR00789. (CONF-930151–3: 1. Optical Society of America (OSA) meeting on high resolution spectroscopy, Salt Lake City, UT (United States), 18-21 Jan 1993). Order Number DE93003906. Source: OSTI; NTIS; INIS; GPO Dep.

High resolution Raman studies of the Q branch in H_2 perturbed by Ar are relevant to combustion diagnostics and for tests of the intermolecular potential. The use of spectroscopic techniques to study combustion requires accurate models for the line shapes which can range from Lorentzian to Gaussian to more complicated profiles depending on the perturber species, perturber concentration, density and temperature. Calculations with these models require estimates of the speed dependence of the line-shift and line-broadening coefficients. Modern theories are now able to predict the shifting and broadening resulting from collisions but are hampered by uncertainties in the interaction potential. One of the most studied potentials is that of H_2-Ar which has the advantage of being theoretically tractable for line shape computations. Furthermore, since the masses of Ar and molecular O_2 and N_2 are similar, spectral features depending on the perturber's mass are expected to be similar. We report preliminary measurements of the density shift of the Q branch lines in H_2 as a function of rotational state and temperature.

6194 (UCRL–53943-91, pp. 44-46) **Pressure dependence of the reaction propagation rate of TATB at high pressure.** Foltz, M.F. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

The insensitive high explosive 1,3,5-triamino-2,4,6-trinitrobenzene (TATB), ignited by a laser under high pressure in a diamond anvil cell, exhibits reaction propagation rates (RPR) that are strongly pressure dependent. The observed sawtooth shape of the RPR-vs-pressure curve suggests pressure-induced transitions to higher density phases. A proposed molecular rearrangement, such as that of graphite to diamond, would produce a very stable, dense 3-D network of stacked molecular rings.

6195 (UCRL–53943-91, pp. 148-151) **A time-resolved diffraction study of the Ta-C solid combustion system.** Wong, J.; Larson, E.M.; Holt, J.B.; Waide, P.A.; Rupp, B.; Terminello, L.J. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

The adiabatic temperatures, T_{ad}, for the combustion synthesis of TaC and Ta_2C are calculated from known thermodynamic data to

be 2452 and 2376 C, respectively. These maximum reaction temperatures are well below the melting points of tantalum, carbon, and the corresponding products and eutectic temperatures known in the binary Ta-C phase diagram. Hence, a liquid phase does not form, and the syntheses are truly solid combustions. In the formation of TaC, a concurrent subcarbide Ta_2C phase forms, persists for a couple of seconds, and decreases in intensity as the final TaC phase attains its maximum concentration. The formation of Ta_2C proceeds directly with no discernible intermediate Ta-C phase within 50 ms. This experimental approach can be used to study the chemical dynamics of high-temperature, solid-state phenomena and to provide the data base needed to test various models for the solid-combustion process.

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6196 (AUC-IBT-R-9204) **Scandinavian forum for stochastic mechanics.** Aakjaer, K. (ed.). Aalborg Universitetscenter (Denmark). Inst. for Bygningsteknik. Feb 1992. 170p. (CONF-9111281--: 2. Scandinavian forum for stochastic mechanics, Aalborg (Denmark), 21-22 Nov 1991). Order Number DE93752802. Source: OSTI; NTIS.

Scandinavian Forum for Stochastic Mechanics is a symposium for people working in the field of applied stochastic methods in Denmark, Finland, Iceland, Norway and Sweden. The intention of this type of conference is to bring people from the Nordic countries, with an interest in applied stochastic mechanics, together for informal discussions of recent results and ongoing work. It should be seen as a forum for discussions of applied stochastic methods. A total of 24 presentations were given at the symposium covering a wide variety of topics. The participants were invited to submit written versions of their contributions, and this report contains the result. (AB).

6197 (DOE/ER/13331-T4) **The collaborative program of research in engineering sciences: Annual report, September 1, 1991-August 31, 1992.** Hardt, D.E. (Massachusetts Inst. of Tech., Cambridge, MA (United States). Energy Lab.). Massachusetts Inst. of Tech., Cambridge, MA (United States). Energy Lab.; Idaho National Engineering Lab., Idaho Falls, ID (United States). Sep 1992. 44p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-85ER13331. Order Number DE93005126. Source: OSTI; NTIS; GPO Dep.

In 1985, the Energy Laboratory of the Massachusetts Institute of Technology (MIT) and the Idaho National Engineering Laboratory (INEL) began a collaborative program of energy-related engineering research. This program was extended for another three years starting in January 1991. The program continues to pursue three broad goals: to perform quality research on energy-related technologies involved in industrial processes and productivity; to demonstrate the potential of collaborative programs between universities and the national laboratories; and to encourage the transfer of the technology developed to the industrial sector. This annual report describes progress at MIT under the MIT/INEL program during the past year.

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Refer also to citation(s) 5067, 5114, 5115, 5177, 5601, 5889, 5908, 6243, 6244, 6452, 6652, 7372, 7447, 7477

6198 (AEA-RS-5207) **The penetration of micron-sized spherical particles through ultrafine capillaries of short length.** Morton, D.A.V.; North, B.M.; Mitchell, J.P. AEA Reactor Services, Winfrith (United Kingdom). Sep 1991. [17] Order Number DE93609360. Source: OSTI; NTIS (US Sales Only); INIS.

The penetration of 2 to 20 μm diameter glass microsphere aerosols is reported for short capillaries with lengths ranging from 5 to 20 mm and bore varying from 5 to 20 μm. The techniques used to investigate aerosol penetration were the same as reported previously for longer capillaries. Both sets of penetration data are important in assessing the potential leakage of airbone particles through seals of containers used to transport nuclear materials; in the most recent experiments the leak path lengths corresponded closely to the worst-case conditions of a straight breach in the elastomer seal of the container. (author).

6199 (ANL/CP-75488) **Wind induced vibration of a stack.** Chen, S.S.; Cai, Y. Argonne National Lab., IL (United States). [1992]. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-921110-39: Winter annual meeting of the American Society of Mechanical Engineers (ASME), Anaheim, CA (United States), 8-13 Nov 1992). Order Number DE93004246. Source: OSTI; NTIS; GPO Dep.

A stack supported by guy wires at four levels is subjected to large-amplitude oscillations when the wind speed is over 15 m/s. The excitation mechanisms are identified based on scoping calculations, analytical prediction using a finite element code, and observation of the stack/wire response. The stack is determined to be excited by vortex shedding. Once lock-in resonance occurs, the guy wires are excited by the transverse motion of the stack. Large-amplitude oscillations of the guy wires are due to parametric resonance. Several methods are recommended to alleviate vibrational problem for short-term and long-term solutions. A new stack which is modified based on the results of this study is not subjected to any unacceptable oscillations.

6200 (ANL/CP-76686) **Contact-impact simulations on massively parallel SIMD supercomputers.** Plaskacz, E.J. (Argonne National Lab., IL (United States)); Belytscko, T.; Chiang, H.Y. Argonne National Lab., IL (United States). [1992]. 29p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-921210-3: Symposium for high-performance computing for flight vehicles, Washington, DC (United States), 7-9 Dec 1992). Order Number DE93004188. Source: OSTI; NTIS; GPO Dep.

The implementation of explicit finite element methods with contact-impact on massively parallel SIMD computers is described. The basic parallel finite element algorithm employs an exchange process which minimizes interprocessor communication at the expense of redundant computations and storage. The contact-impact algorithm is based on the pinball method in which compatibility is enforced by preventing interpenetration on spheres embedded in elements adjacent to surfaces. The enhancements to the pinball algorithm include a parallel assembled surface normal algorithm and a parallel detection of interpenetrating pairs. Some timings with and without contact-impact are given.

6201 (CONF-9109447-1) **Monitoring of vibrating machinery using artificial neural networks.** Alguindigue, I.E. (Tennessee Univ., Knoxville, TN (United States). Dept. of Nuclear Engineering); Loskiewicz-Buczak, A.; Uhrig, R.E. Tennessee Univ., Knoxville, TN (United States). Dept. of Nuclear Engineering. [1991]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG07-88ER12824 ;AC05-84OR21400. From 2. government neural network applications workshop; Huntsville, AL (United States); 10-12 Sep 1991. Order Number DE93003566. Source: OSTI; NTIS; INIS; GPO Dep.

The primary source of vibration in complex engineering systems is rotating machinery. Vibration signatures collected from these components render valuable information about the operational state of the system and may be used to perform diagnostics. For example, the low frequency domain contains information about unbalance, misalignment, instability in journal bearing and mechanical looseness; analysis of the medium frequency range can render information about faults in meshing gear teeth; while the high frequency domain will contain information about incipient faults in rolling-element bearings. Trend analysis may be performed by comparing the vibration spectrum for each machine with a reference spectrum and evaluating the vibration magnitude changes at different frequencies. This form of analysis for diagnostics is often performed by maintenance personnel monitoring and recording transducer signals and analyzing the signals to identify the operating condition of the machine. With the advent of portable fast Fourier transform (FFT) analyzers and "laptop" computers, it is possible to collect and analyze vibration data an site and detect incipient failures several weeks or months before repair is necessary. It is often possible to estimate the remaining life of certain systems once a fault has been detected. RMS velocity, acceleration, displacements, peak value, and crest factor readings can be collected

from vibration sensors. To exploit all the information embedded in these signals, a robust and advanced analysis technique is required. Our goal is to design a diagnostic system using neural network technology, a system such as this would automate the interpretation of vibration data coming from plant-wide machinery and permit efficient on-line monitoring of these components.

6202 (CONF-9202142–1) **Use of neural networks in the analysis of complex systems.** Uhrig, R.E. (Tennessee Univ., Knoxville, TN (United States). Dept. of Nuclear Engineering). Oak Ridge National Lab., TN (United States); Tennessee Univ., Knoxville, TN (United States). Dept. of Nuclear Engineering. [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG07-88ER12824 ;AC05-84OR21400. From WNN-92: workshop on neural networks; Album, AL (United States); 10-12 Feb 1992. Order Number DE93003554. Source: OSTI; NTIS; INIS; GPO Dep.

The application of neural networks, alone or in conjunction with other advanced technologies (expert systems, fuzzy logic, and/or genetic algorithms) to some of the problems of complex engineering systems has the potential to enhance the safety reliability and operability of these systems. The work described here deals with complex systems or parts of such systems that can be isolated from the total system. Typically, the measured variables from the systems are analog variables that must be sampled and normalized to expected peak values before they are introduced into neural networks. Often data must be processed to put it into a form more acceptable to the neural network. The neural networks are usually simulated on modern high-speed computers that carry out the calculations serially. However, it is possible to implement neural networks using specially designed microchips where the network calculations are truly carried out in parallel, thereby providing virtually instantaneous outputs for each set of inputs. Specific applications described include: Diagnostics: State of the Plant; Hybrid System for Transient Identification; Detection of Change of Mode in Complex Systems; Sensor Validation; Plant-Wide Monitoring; Monitoring of Performance and Efficiency; and Analysis of Vibrations. Although the specific examples described deal with nuclear power plants or their subsystems, the techniques described can be applied to a wide variety of complex engineering systems.

6203 (CONF-921102–35) **A historical perspective of remote operations and robotics in nuclear facilities: Robotics and Intelligent Systems Program.** Herndon, J.N. Oak Ridge National Lab., TN (United States). [1992]. 63p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Joint American Nuclear Society (ANS)/European Nuclear Society (ENS) international meeting on fifty years of controlled nuclear chain reaction: past, present, and future; Chicago, IL (United States); 15-20 Nov 1992. Order Number DE93004118. Source: OSTI; NTIS; INIS; GPO Dep.

The field of remote technology is continuing to evolve to support man's efforts to perform tasks in hostile environments. The technology which we recognize today as remote technology has evolved over the last 45 years to support human operations in hostile environments such as nuclear fission and fusion, space, underwater, hazardous chemical, and hazardous manufacturing. The four major categories of approach to remote technology have been (1) protective clothing and equipment for direct human entry, (2) extended reach tools using distance for safety, (3) telemanipulators with barriers for safety, and (4) teleoperators incorporating mobility with distance and/or barriers for safety. The government and commercial nuclear industry has driven the development of the majority of the actual teleoperator hardware available today. This hardware has been developed largely due to the unsatisfactory performance of the protective-clothing approach in many hostile applications. Manipulation systems which have been developed include crane/impact wrench systems, unilateral power manipulators, mechanical master/slaves, and servomanipulators. Viewing systems have included periscopes, shield windows, and television systems. Experience over the past 45 years indicates that maintenance system flexibility is essential to typical repair tasks because they are usually not repetitive, structured, or planned. Fully remote design (manipulation, task provisions, remote tooling, and facility synergy) is essential to work task efficiency. Work for space applications has been primarily research oriented with relatively few successful space applications, although the shuttle's remote manipulator system has been quite successful. In the last decade, underwater applications have moved forward significantly, with the offshore oil industry and military applications providing the primary impetus.

6204 (CONF-930339–1) **Driving a car using reflexive fuzzy behaviors.** Pin, F.G.; Watanabe, Y. Oak Ridge National Lab., TN (United States). [1992]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 2. IEEE international conference on fuzzy systems; San Francisco, CA (United States); 28 Mar - 1 apr 1993. Order Number DE93001214. Source: OSTI; NTIS; GPO Dep.

Vehicle control in a-priori unknown, unpredictable, and dynamic environments requires many calculational and reasoning schemes to operate on the basis of very imprecise, incomplete, or unreliable data. For such systems, in which all the uncertainties can not be engineered away, approximate reasoning may provide an alternative to the complexity and computational requirements of conventional uncertainty analysis and propagation techniques. Two types of computer boards including custom-designed VLSI chips have been developed to add a fuzzy inferencing capability to real-time control systems. All inferencing rules on a chip are processed in parallel, allowing execution of the entire rule base in about 30 μsec, and therefore, making control of "reflex-type" of motions envisionable. The use of these boards and the approach using superposition of elemental sensor-based behaviors for the development of qualitative reasoning schemes emulating human-like navigation in a-prioii unknown environments are discussed. We describe how the human-like navigation scheme implemented on one of the qualitative inferencing boards was installed on a test-bed platform to investigate two control modes for driving a car in a-priori unknown environments on the basis of sparse and imprecise sensor data. In the first mode, the car navigates autonomously, while in the second mode, the system acts as a driver's aid providing the driver with linguistic (fuzzy) commands to turn left or right and speed up or slow down depending on the obstacles perceived by the sensors. Experiments with both modas of control are described in which the system uses only three acoustic range (sonar) sensor charmers to perceive the environment. Simulation results as well as indoor and outdoor experiments are discussed to illustrate the feasibility and robustness of autonomous navigation and/or safety enhancing driver's aid using the new fuzzy inferencing hardware system and some human-like reasoning schemes.

6205 (DOE/CE/15361–T1) **Accurate measure by weight of liquids in industry: Final report.** Muller, M.R. Rutgers–the State Univ., Piscataway, NJ (United States). Dept. of Mechanical and Aerospace Engineering. 12 Dec 1992. 71p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG01-89CE15361. Order Number DE93005056. Source: OSTI; NTIS; GPO Dep.

This research's focus was to build a prototype of a computerized liquid dispensing system. This liquid metering system is based on the concept of altering the representative volume to account for temperature changes in the liquid to be dispensed. This is actualized by using a measuring tank and a temperature compensating displacement plunger. By constantly monitoring the temperature of the liquid, the plunger can be used to increase or decrease the specified volume to more accurately dispense liquid with a specified mass. In order to put the device being developed into proper engineering perspective, an extensive literature review was undertaken on all areas of industrial metering of liquids with an emphasis on gravimetric methods.

6206 (DOE/EA–0618) **Integrated Voice/Data Telecommunications System, US Department of Energy Hanford Site, Richland, Washington: Environmental assessment.** USDOE Richland Field Office, WA (United States). Apr 1992. 20p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93003075. Source: OSTI; NTIS; INIS; GPO Dep.

The Integrated Voice/Data Telecommunications System (IVDTS) would replace the present Hanford Site telephone system and add additional data service. The system would be constructed primarily within existing disturbed areas on and off the Hanford Site. No aspect of the system construction appears to have a potential significant impact on the quality of the human environment.

6207 (DPSPU–74-124-5-Rev.2) **Safety analysis report – Packages LP-50 tritium package (Packaging of fissile and other radioactive materials): Final report: Revision 2.** Gates, A.A.; McCarthy, P.G.; Edl, J.W.; Chalfant, G.G. (comps.); Cadelli, G. Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Savannah River Plant. May 1975. 137p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001 ;AC09-89SR18035. Order Number DE93003182. Source: OSTI; NTIS; GPO Dep.

Elemental tritium is shipped at low pressure in a stainless steel container (LP-50) surrounded by an aluminum vessel and Celotex insulation at least 4 in. thick in a steel drum. Each package contains a large quantity (greater than a Type A quantity) of nonfissile material, as defined in AECM 0529. This report provides the details of the safety analysis performed for this type container.

6208 (JAERI-M–92-078) **Development of plastic capsule for research reactor irradiation.** Arigane, Kenji (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Shida, Shigeo; Waragai, Heita; Aoyama, Isao; Takahashi, Hidetake; Seguchi, Tadao. Japan Atomic Energy Research Inst., Tokyo (Japan). Jun 1992. 28p. (In Japanese). Order Number DE93753186. Source: OSTI; NTIS; INIS.

New irradiation capsule for the research reactor was developed using a radiation resistant polymer, Polyethylene-2, 6-Naphthalate (PEN). This capsule has several merits such as low activity after irradiation, low price by mass production using injection moulding, and good irradiation performance for application to 12 hours irradiation in Japan Research Reactor No. 4 (JRR-4). Using this capsule, more efficient irradiation can be done because the sample can be taken off from the capsule immediately after irradiation, and this PEN capsule can be replaced with ordinary aluminum capsule for JRR-4 irradiation. This report describes the development of PEN capsule and the irradiation tests. (author).

6209 (JAERI-M–92-112) **Basic experiment on an ultrasonic method of localization.** Fujii, Yoshio (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Inomata, Shinji; Suzuki, Katsuo; Suzudo, Tomoaki; Shinohara, Yoshikuni. Japan Atomic Energy Research Inst., Tokyo (Japan). Aug 1992. 70p. (In Japanese). Order Number DE93754295. Source: OSTI; NTIS; INIS.

This report describes the results of the basic experiment on ultrasonic method of localization of mobile robots working in very strong radiation environments in nuclear facilities or in a room filled with opaque medium such as dense smoke where video cameras cannot function. The basic characteristics of the ultrasonic sensors used, the outline of the system for sensor signal processing and the parallel processing method for structured programs are also described. The results of the experiment show that it is possible to identify the location with sufficient accuracy by proper use of the ultrasonic sensors and of signal processing method. It is also shown that countermeasures must be taken to organize a precise and stable measurement system. The parallel processing method applied in this experiment is effective on which uses synchronization for communication among multiple structured processes and can also be applied to other sensor signal processing systems. (author).

6210 (KCP–613-4885) **Process waste assessment methodology for lab equipment and glassware cleaning: Final report.** Jones, L.A. Allied-Signal Aerospace Co., Kansas City, MO (United States). Kansas City Div. Dec 1992. 113p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00613. Order Number DE93004824. Source: OSTI; NTIS; GPO Dep.

The methodology for conducting process waste assessments (PWAs) was investigated, and a PWA was conducted for lab equipment cleaning. The worksheets set forth in the Process Waste Assessment Guidance issued by Environment, Safety and Health (ES&H) were modified to lead a team through a PWA with minimal training and to consolidate repetitive information. This information was presented to a working subcommittee of the plant-wide PWA team for further refinement and is near completion.

6211 (KCP–613-4967) **Advanced engineering analysis.** Freeman, W.R. Allied-Signal Aerospace Co., Kansas City, MO (United States). Kansas City Div. Nov 1992. 39p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00613. Order Number DE93004823. Source: OSTI; NTIS; GPO Dep.

The Advanced Engineering Analysis project is being used to improve the breadth of engineering analysis types, the particular phenomena which may be simulated, and also increase the accuracy and usability of the results of both new and current types of simulations and analyses. This is an interim report covering several topics under this project. Information on two new implementations of failure criteria for metal forming, the implementation of coupled fluid flow/heat transfer analysis capabilities, the integration of experimental shock and vibration test data with analyses, a correction to a contact solution problem with a 3-D parabolic brick finite element, and the development and implementation of a file translator to link IDEAS to DYNA3D is provided in this report.

6212 (LA-UR–92-3581) **On using scattering statistics for ultra wideband electromagnetic target classification and identification.** Miller, E.K. Los Alamos National Lab., NM (United States). [1992]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9210166–3: 4. international conference on ultra-wideband, short-pulse electromagnetics, Brooklyn, NY (United States), 8-10 Oct 1992). Order Number DE93003809. Source: OSTI; NTIS; GPO Dep.

An interrogating electromagnetic field has information encoded upon it by any target from which it scatters. This process presents the electomagneticest/signal processor with a problem that ranges across questions such as (1)Detection–Is there a target? (2) To which class does that target belong? (3) What specific member of that class is the target? (4) What are the targets electrical and/or geometrical properties? in increasing order of specificity and information requirements. Radar systems have been analyzed primarily from the perspective of (1) above. In recent years, however, increasing attention has been devoted to questions 2–4, as the need for more specific and complete information beyond target detection has arisen. In the following discussion, we present conceptually a statistics, information-oriented approach to this general class of problems.

6213 (LA-UR–92-3777) **Design principles for target stations and methods of remote handling at PSI.** Steiner, E.W. Los Alamos National Lab., NM (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9210121–2: Workshop on the production and use of intense radioactive ion beams for the IsoSpin Laboratory, Oak Ridge, TN (United States), 7-10 Oct 1992). Order Number DE93003835. Source: OSTI; NTIS; INIS; GPO Dep.

Two design concepts for target stations used at Paul Scherrer Institute (PSI) are shown. The method of the remote handling of activated elements is described and some conclusions with respect to a radioactive beam facility are given.

6214 (LA-UR–92-3797) **MANYCOIL and MAGNET: Software for polyhelical magnet design.** Hodgdon, M.; Deninger, W.; Langer, R. Los Alamos National Lab., NM (United States). [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-921133–3: 6. international conference on megagauss magnetic field generation and related topics, Albuquerque, NM (United States), 9-12 Nov 1992). Order Number DE93003840. Source: OSTI; NTIS; GPO Dep.

The charter of the National High Magnetic Field Laboratory calls for the design and implementation of a series of pulsed solenoidal magnets at field levels between 20 and 60 Tesla. The design of these magnets requires the selection of the physical configuration and materials and the design of the external circuits. The goal is a magnetic that will yield the required magnetic field in the bore. However, because of the size of the fields and the forces on the magnet, close attention must also be paid to its electrical and mechanical strength. In addition, the magnet must satisfy temperature constraints imposed by the materials. Thermal excursions must also be kept to a minimum to allow for a reasonable recooling time between pulse. Because of the coupled nature of the many aspects of the magnet, the design of such magnets can be difficult. In the initial stage of the design, one can make use of procedures given engineering handbooks and in computer codes which often specialize in only one aspect of the magnet, such as circuit design.

For the final stage, in which nearly complete designs are studied in detail, one can make use of a variety of sophisticated finite element codes. However, for the stage between initial and nearly completed design, there are no convenient computational tools. While initially one is content to work with an average current density and the general size and aspect ratio of the magnet, the designer in the intermediate stage needs to quantify the effects of changes in wire size, or conducting materials, or the number of turns in a layer. In this stage, the inductance of the magnet, its response to the external circuits, its temperature rise, and field and temperature dependent changes in resistivity are important. The codes MAGNET and MANYCOIL were written to provide fast, convenient computational tools for this intermediate design stage.

6215 (LA-UR-92-3837) **Often overlooked electrical hazards common in many lasers.** Thomas, D.K. Los Alamos National Lab., NM (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-921233--1: international laser safety conference on non-beam hazards, Cincinnati, OH (United States), 1-4 Dec 1992). Order Number DE93003856. Source: OSTI; NTIS; GPO Dep.

One of the more dangerous non-beam hazards associated with laser work is electricity, often found in lethal doses within laser housings. However, some of the paths by which laser personnel may be exposed to this hazard are often overlooked by laser safety officers (LSOs), laser workers and laser manufacturers. One of the often overlooked paths by which laser personnel may come into contact with hazardous electrical current is due to a safety design deficiency prevalent in many laser products. This is that many lasers have performance adjustments within the protective housing that may obligate or entice personnel to perform potentially hazardous manipulative operations with the housing open; often with the safety interlocks defeated and the device fully energized. LSOs, laser workers and laser manufacturers need to be aware of this hazard and should carefully analyze their lasers to determine if this peril exists within the lasers they use or manufacture. In most cases simple measures can be taken to prevent a potentially shocking laser experience.

6216 (ORNL/TM-12056) **Development of the Symbolic Manipulator Laboratory modeling package for the kinematic design and optimization of the Future Armor Rearm System robot: Ammunition Logistics Program.** March-Leuba, S. (Oak Ridge National Lab., TN (United States)); Jansen, J.F.; Kress, R.L.; Babcock, S.M.; Dubey, R.V. Oak Ridge National Lab., TN (United States). Aug 1992. 118p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93003676. Source: OSTI; NTIS; GPO Dep.

A new program package, Symbolic Manipulator Laboratory (SML), for the automatic generation of both kinematic and static manipulator models in symbolic form is presented. Critical design parameters may be identified and optimized using symbolic models as shown in the sample application presented for the Future Armor Rearm System (FARS) arm. The computer-aided development of the symbolic models yields equations with reduced numerical complexity. Important considerations have been placed on the closed form solutions simplification and on the user friendly operation. The main emphasis of this research is the development of a methodology which is implemented in a computer program capable of generating symbolic kinematic and static forces models of manipulators. The fact that the models are obtained trigonometrically reduced is among the most significant results of this work and the most difficult to implement. Mathematica, a commercial program that allows symbolic manipulation, is used to implement the program package. SML is written such that the user can change any of the subroutines or create new ones easily. To assist the user, an on-line help has been written to make of SML a user friendly package. Some sample applications are presented. The design and optimization of the 5-degrees-of-freedom (DOF) FARS manipulator using SML is discussed. Finally, the kinematic and static models of two different 7-DOF manipulators are calculated symbolically.

6217 (PFC/RR-92-11) **A high-power 95 GHz gyro-TWT amplifier.** Kreischer, K.E.; Basten, M.; Blank, M.; Danly, B.G.; Guss, W.C.; Temkin, R.J. Massachusetts Inst. of Tech., Cambridge, MA (United States). Plasma Fusion Center. Jul 1992. 55p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC02-78ET51013. Order Number DE93002332. Source: OSTI; NTIS; GPO Dep.

The need for radar systems with greater resolution has led to renewed interest in the development of efficient high-power amplifiers at 95 GHz. The gyro-TWT is capable of producing high power with the added attraction of having lower ohmic loading on the smooth fast-wave interaction circuit than conventional slow-wave sources. We have completed a comprehensive desip of a 95 GHz gyro-TWT amplifier that is capable of producing 120 kill of output power with an efficiency of 30%, a saturated gain of 38 dB and an instantaneous bandwidth of over 5 GHz. Our concept uses an annular beam produced by a MIG electron source and operates in the $TE_{5,1}$ cylindrical waveguide mode. Realistic beam parameters from gun simulations were, included in our efficiency calculations. In addition, our design includes the use of a compact superconducting magnet, quasi-optical input and output couplers and a sever to supress oscillations. The overall mechanical design shows that a compact, lightweight amplifier with adequate beam clearance is possible. This report also includes a study of a gyro-TWT using a solid on-axis beam from a Pierce-wiggler electron source coupling with a $TE_{1,n}$ waveguide mode. Nonlinear models indicated that an efficient interaction with the waveguide mode was possible, however, beam simulations indicated that the high current density beam had large internal space charge forces that caused a substantial degradation of the beam quality.

6218 (PNL-8455) **Frequency domain transfer function identification using the computer program SYSFIT.** Trudnowski, D.J. Pacific Northwest Lab., Richland, WA (United States). Dec 1992. 85p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93005598. Source: OSTI; NTIS; GPO Dep.

Because the primary application of SYSFIT for BPA involves studying power system dynamics, this investigation was geared toward simulating the effects that might be encountered in studying electromechanical oscillations in power systems. Although the intended focus of this work is power system oscillations, the studies are sufficiently genetic that the results can be applied to many types of oscillatory systems with closely-spaced modes. In general, there are two possible ways of solving the optimization problem. One is to use a least-squares optimization function and to write the system in such a form that the problem becomes one of linear least-squares. The solution can then be obtained using a standard least-squares technique. The other method involves using a search method to obtain the optimal model. This method allows considerably more freedom in forming the optimization function and model, but it requires an initial guess of the system parameters. SYSFIT employs this second approach. Detailed investigations were conducted into three main areas: (1) fitting to exact frequency response data of a linear system; (2) fitting to the discrete Fourier transformation of noisy data; and (3) fitting to multi-path systems. The first area consisted of investigating the effects of alternative optimization cost function options; using different optimization search methods; incorrect model order, missing response data; closely-spaced poles; and closely-spaced pole-zero pairs. Within the second area, different noise colorations and levels were studied. In the third area, methods were investigated for improving fitting results by incorporating more than one system path. The following is a list of guidelines and properties developed from the study for fitting a transfer function to the frequency response of a system using optimization search methods.

6219 (SAND-90-2406) **A method for determining the spent-fuel contribution to transport cask containment requirements.** Sanders, T.L. (Sandia National Labs., Albuquerque, NM (United States)); Seager, K.D.; Rashid, Y.R.; Barrett, P.R.; Malinauskas, A.P.; Einziger, R.E.; Jordan, H.; Duffey, T.A.; Sutherland, S.H. Sandia National Labs., Albuquerque, NM (United States). Nov 1992. 552p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (TTC-1019). Order Number DE93004596. Source: OSTI; NTIS; INIS; GPO Dep.

This report examines containment requirements for spent-fuel transport containers that are transported under normal and hypothetical accident conditions. A methodology is described that estimates the probability of rod failure and the quantity of radioactive material released from breached rods. This methodology characterizes the dynamic environment of the cask and its contents and deterministically models the peak stresses that are induced in spent-fuel cladding by the mechanical and thermal dynamic environments. The peak stresses are evaluated in relation to probabilistic failure criteria for generated or preexisting ductile tearing and material fractures at cracks partially through the wall in fuel rods. Activity concentrations in the cask cavity are predicted from estimates of the fraction of gases, volatiles, and fuel fines that are released when the rod cladding is breached. Containment requirements based on the source term are calculated in terms of maximum permissible volumetric leak rates from the cask. Calculations are included for representative cask designs.

6220 (SAND–92-1429C) **A comparison of force reconstruction methods for a lumped mass beam.** Bateman, V.I.; Mayes, R.L.; Carne, T.G. Sandia National Labs., Albuquerque, NM (United States). [1992]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9210176–4: 63. shock and vibration symposium, Las Cruces, NM (United States), 27 Oct 1992). Order Number DE93002461. Source: OSTI; NTIS; GPO Dep.

Two extensions of the force reconstruction method, the Sum of Weighted Accelerations Technique (SWAT), are presented in this paper; and the results are compared to those obtained using SWAT. SWAT requires the use of the structure's elastic mode shapes for reconstruction of the applied force. Although based on the same theory, the two, new techniques do not rely on mode shapes to reconstruct the applied force and may be applied to structures whose mode shapes are not available. One technique uses the measured force and acceleration responses with the rigid body mode shapes to calculate the scalar weighting vector, so the technique is called SWAT-CAL (SWAT using a CALibrated force input). The second technique uses only the free-decay time response of the structure with the rigid body mode shapes to calculate the scalar weighting vector and is called SWAT-TEEM (SWAT using Time Eliminated Elastic Modes).

6221 (SAND–92-1975C) **Rapid mesh generation for finite element analysis of investment castings.** Lober, R.R.; Bohnhoff, W.J.; Meyers, R.J. Sandia National Labs., Albuquerque, NM (United States). [1992]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9210203–2: 40. annual Investment Casting Institute (ICI) technical meeting, Las Vegas, NV (United States), 4-7 Oct 1992). Order Number DE93002287. Source: OSTI; NTIS; GPO Dep.

FASTCAST is a Sandia National Laboratories program to produce investment cast prototypical hardware faster by integrating experimental and computational technologies into the casting process. FASTCAST uses the finite element method to characterize the metal flow and solidification processes to reduce uncertainty in the mold design. For the casting process to benefit from finite element analysis, analysis results must be available in a very short time frame. By focusing on the bottleneck of finite element model creation, automated mesh generation can drastically reduce the time span between geometry definition (design) and accurate analysis results. The increased availability of analysis results will diminish the need for trial and error approaches to acquiring production worthy mold and gating systems for investment casting. The CUBIT meshing tool kit is being developed to address the need for rapid mesh generation. CUBIT is being designed to effectively automate the generation of quadrilateral and hexahedral elements. It is a solid-modeler based, two- and three-dimensional preprocessor that prepares solid models for finite element analysis. CUBIT contains several meshing algorithms including two- and three-dimensional mapping, two- and three-dimensional paving (patented), and a general two and one-half dimensional sweeper based upon the plastering algorithm. This paper describes progress in the development of the CUBIT meshing toolkit.

6222 (SAND–92-2151C) **Transient dynamics capability at Sandia National Laboratories.** Attaway, S.W.; Biffle, J.H.; Sjaardema, G.D.; Heinstein, M.W.; Schoof, L.A. Sandia National Labs., Albuquerque, NM (United States). [1992]. 44p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9209260–1: Workshop on computational methods for crashworthiness, Hampton, VA (United States), 2-3 Sep 1992). Order Number DE93002285. Source: OSTI; NTIS; GPO Dep.

This report will present a brief overview of the transient dynamics capabilities at Sandia National Laboratories, with an emphasis on recent new developments and current research. In addition, the Sandia National Laboratories (SNL) Engineering Analysis Code Access System (SEACAS), which is a collection of structural and thermal codes and utilities used by analysts at SNL, will be described. The SEACAS system includes pre- and post-processing codes, analysis codes, database translation codes, support libraries, Unix shell scripts for execution, and an installation system. SEACAS is used at SNL on a daily basis as a production, research, and development system for the engineering analysts and code developers. Over the past year, approximately 190 days of CPU time have been used by SEACAS codes on jobs running from a few seconds up to two and one-half days of CPU time. SEACAS is running on several different systems at SNL including Cray Unicos, Hewlett Packard HP-UX, Digital Equipment Ultrix, and Sun SunOS. An overview of SEACAS, including a short description of the codes in the system, will be presented. Abstracts and references for the codes are listed at the end of the report.

6223 (TKK-S/SM–1989/21, pp. 115-122) **Robot servo-drives control system.** Kulmar, L. (Tallinn Technical Univ. (Estonia). Dept. of Electrical Drives); Lehtla, T. Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Electromechanics. 1989. (CONF-8901144–: Symposium on electrical power engineering at the Helsinki University of Technology, Espoo (Finland), 27 Jan 1989). In *Symposium on electrical power engineering.* 130p. Order Number DE93711132. Source: OSTI; NTIS.

This present paper is concerned with the energy saving problem in control systems for robots. The previous analysis and the graphs, given in the figures help to project the serve drives and to find the optimum structure in their control.

6224 (TVA-Bull–Z-307) **Secondary containment large fertilizer storage tanks.** Waddell, E.L.; Broder, M.F. National Fertilizer and Environmental Research Center, Muscle Shoals, AL (United States). [1991]. 48p. Sponsored by Tennessee Valley Authority, Knoxville, TN (United States). (CONF-9107244–1: Illinois Fertilizer and Chemical Association's large tank clinic, Springfield, IL (United States), 17 Jul 1991). Order Number DE93002588. Source: OSTI; NTIS.

The large quantities of fertilizer and pesticide, which are handled by retail facilities, have made these operations the target of regulations aimed at protecting water supplies. These regulations and dealers' desire to protect water supplies have made environmental protection a primary concern. Currently, nine states have adopted regulations which require secondary containment of fertilizers and agrichemicals. An additional seven states are developing regulations. Volume requirements and performance specifications of secondary containment structures for fertilizer storage tanks are included in all regulations. Among the different containment problems presented by retail sites, the large tanks (tanks with capacities greater than 100,000 gallons) present the greatest challenge for design and cost evaluation to determine the most effective containment system. The objective of this paper is to provide secondary containment designs for large fertilizer tanks using readily available construction materials. These designs may be innovative to some extent, but they must incorporate field experience and knowledge from trials, errors, and successful installations for existing and newly constructed fertilizer storage tanks. Case studies are presented to indicate projected costs for these alternatives.

6225 (WHC-SA–1606) **Improving the selection of bolted joint parameters by using results from finite-element analysis.** Ziada, H.H. Westinghouse Hanford Co., Richland, WA (United States). Oct 1992. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-930361–1: 1993 American Society of Mechanical Engineers (ASME) national design engineering conference, Chicago, IL (United

States), 7-11 Mar 1993). Order Number DE93002243. Source: OSTI; NTIS; GPO Dep.

Finite-element techniques were used to determine the combination of parameters that would produce the optimum design for the bolted joint. A finite-element model was constructed from a combination of two-dimensional isoparametric axisymmetric solid elements and gap elements. The gap elements represented the physical contact between the plate and bolt head and the plate and nut. The model was used to determine the stress patterns, displacements, and contact areas (separation diameters) across the bolted joint. Computed results for the contact area showed the following: the contact area is determined by joint design, not bolt Toad magnitude; joint thickness, plate thickness ratio, and bolthead dimensions have a pronounced effect on the contact area; and the maximum contact area occurs with plates of equal thickness. The change in separation diameters (D) can be presented in a simple straight-line expression D/d = 1 + 1.1 (L/d), where L = joint thickness and d = bolt diameter. The stress results indicated that neither load nor stress distribution under the bolt head or nut is constant or uniform. Bolt-head dimensions, joint thickness, and plate thickness ratio markedly affect the developed stresses, with the maximum stress value occurring at the bolt-plate interface. Beyond the bolt head, maximum stress develops at the interface plane of the bolted plates, with that stress decreasing as the plate thickness ratio increases reaching its lowest value at the equal-thickness ratio. These results indicate that design stiffness formulas used heretofore are not adequate. Results provided by this analysis should prove more effective in achieving optimum bolt design for bolted joints.

6226 (Y/EN–4665) **Making old buildings meet new standards.** Denton, D.R.; Beavers, J.E.; Stoddart, W.C.T.; Hunt, R.J. Oak Ridge Y-12 Plant, TN (United States). Aug 1992. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OS21400. (CONF-9209257–1: US-Japan workshop on improvement of structural design and construction practices, San Diego, CA (United States), 8-10 Sep 1992). Order Number DE93002701. Source: OSTI; NTIS; GPO Dep.

Most of the Department of Energy (DOE) facilities managed by Martin Marietta Energy Systems, Inc. (Energy Systems), were constructed before 1970, whereas a large body of technical information relating to the determination of natural phenomena hazards (earthquake, wind/tornado, flood) and analysis and design methodologies have been developed since this date. Much of this new information has been incorporated in the current DOE orders and criteria. The ongoing process of making modifications and updating the safety documentation of the facilities at Oak Ridge requires that these facilities constructed before 1970 be evaluated using current criteria. The impact of natural phenomena requirements contained in new and revised DOE orders on the Oak Ridge Y-12 Plant is described. Specifically, seismic hazards given in Design and Evaluation Guidelines for Department of Energy Facilities Subjected to Natural Phenomena Hazards, UCRL-15910, are compared with both the original seismic design basis and with site-specific hazard curves developed using current DOE methodology. The impact of applying current analysis and design methodologies and higher levels of technical rigor to facilities constructed in the 1940s, 1950s, and 1960s is discussed. Energy Systems' methods of reconciling noncomplying structures with the requirements of current criteria are also presented.

6227 (Y/EN–4765) **Behavior of infilled frames.** Flanagan, R.D. (Oak Ridge Y-12 Plant, TN (United States)); Tenbus, M.A.; Bennett, R.M.; Jamal, B.D. Oak Ridge Y-12 Plant, TN (United States). 21 Sep 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OS21400. (CONF-9209258–1: Unreinforced hollow clay tile workshop, San Francisco, CA (United States), 21-22 Sep 1992). Order Number DE93002749. Source: OSTI; NTIS; GPO Dep.

A review of current analytical methods for infilled frame behavior is conducted. A subset of these methods are applied to experimental results. Parametric studies are used to find the sensitivity of the behavior to various parameters. In-plane loading, out-of-plane inertial loading, out-of-plane interstory drift loading, and combined loadings are examined. Particular reference is made to clay tile infilled frames, and the behavior of clay tile in compression.

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Refer also to citation(s) 5431, 5864, 5865, 5866, 5867, 5868, 5869, 5870, 5871, 5872, 5873, 5878, 5879, 5880, 5881, 5882, 5883, 6824, 7454, 7455, 7469, 7470, 7471, 7472, 7473, 7475

6228 (AEA-RS–1066) **Improvements to TRAC models of condensing stratified flow. Pt. 2: Counter current flow.** Zhang, Q.; Leslie, D.C.; Hewitt, G.F. AEA Reactor Services, Winfrith (United Kingdom). Mar 1991. [22] Project AEA LHT 1.1.9;NSRMU HTH/PWR/04. (PWR/TUG/P–91-119.). Order Number DE93609339. Source: OSTI; NTIS (US Sales Only); INIS.

The Bankoff experiments of condensation in counter-current stratified flow have been simulated by TRAC-PF1/MOD1 and modified TRAC with Bankoff's own correlations of interfacial friction and interfacial heat transfer coefficient (HTC). Steam flow rate and liquid height have been evaluated. Both TRAC and Bankoff HTCs are strongly dependant on the liquid velocity which is related to the liquid height. The calculations show that Bankoff HTC is much better than the TRAC HTC in the prediction of the stream flow rate and is recommended to replace TRAC HTC in the condensing stratified flow. (author).

6229 (AEA-RS–1077) **Improvements to TRAC models of condensing stratified flow. Pt. 1: Co-current flow.** Zhang, Q.; Leslie, D.C. AEA Reactor Services, Winfrith (United Kingdom). Dec 1991. [49] Project AEA LHT 1.1.9;NSRMU HTH/PWR/04. Order Number DE93609340. Source: OSTI; NTIS (US Sales Only); INIS.

Direct contact condensation in stratified flow is an important phenomenon in LOCA analyses. In this report, the TRAC interfacial heat transfer model for stratified condensing flow has been assessed against the Bankoff experiments. A rectangular channel option has been added to the code to represent the experimental geometry. In almost all cases the TRAC heat transfer coefficient (HTC) over-predicts the condensation rates and in some cases it is so high that the predicted steam is sucked in from the normal outlet in order to conserve mass. Based on their cocurrent and countercurrent condensing flow experiments, Bankoff and his students (Lim 1981, Kim 1985) developed HTC models from the two cases. The replacement of the TRAC HTC with either of Bankoff's models greatly improves the predictions of condensation rates in the experiment with cocurrent condensing flow. However, the Bankoff HTC for countercurrent flow is preferable because it is based only on the local quantities rather than on the quantities averaged from the inlet. (author).

6230 (ANL/MCT/CP–76348) **Analysis of liquid-solids suspension velocities and concentrations obtained by NMR imaging.** Ding, J. (Argonne National Lab., IL (United States)); Lyczkowski, R.W.; Sha, W.T.; Altobelli, S.A.; Fukushima, E. Argonne National Lab., IL (United States). Sep 1992. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9209262–1: NSF/DOE workshop on flow of particles and fluids, Gaithersburg, MD (United States), 17-18 Sep 1992). Order Number DE93002905. Source: OSTI; NTIS; GPO Dep.

COMMIX-M, a three-dimensional transient and steady-state computer program written in Cartesian and cylindrical coordinates, has been developed by Argonne National Laboratory. This computer program is capable of analyzing multiphase flow and heat transfer and utilizes the separate phases model wherein each phase has its own mass, momentum, and energy equations. This computer program is in its early stages of development for application to test various interphase interaction models and to predict design and processing of dense fluid-solids suspension systems. COMMIX-M contains preliminary constitutive relationships for interfacial drag, solids viscosities and stresses to describe the solids rheology, and shear lift forces from the literature. Also included is a solids partial slip boundary condition to allow non-zero tangential velocity at the tube walls. Analyses of some of the steady-state, fully-developed isothermal carrier fluid velocity and solids concentration data of

Altobelli et al. and Sinton and Chow are presented. These experimental data obtained using three-dimensional time-of-flight nuclear magnetic (NMR) imaging techniques were carefully performed and represent some of the best available open literature data of their kind. NMR imaging offers powerful techniques to non-intrusively determine three-dimensional time-dependent velocity and concentration fields to assist development and validation of the constitutive models and the computer programs describing concentrated suspensions. Analyses of these NMR data, together with comparisons of computed and measured concentration and velocity profiles provide some insights into the mechanisms governing the observed phenomena. Recommendations for future research are given. To the authors' knowledge, these are the first such comparisons of theory and experiment.

6231 (CONF-9205147–3) **Experimental and numerical investigation of passive scalar dispersal in bounded turbulent shear flows.** Wallace, J.M.; Bernard, P.S.; Balint, J.L.; Ong, L. Maryland Univ., College Park, MD (United States). Dept. of Mechanical Engineering. [1992]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-88ER13838. From 10. symposium on energy engineering sciences: synergism of analysis, modeling, and experiment; Argonne, IL (United States); 11-13 May 1992. Order Number DE93004122. Source: OSTI; NTIS; GPO Dep.

Laboratory experiments and direct numerical simulations (DNS) of passive scalar contaminant dispersal in bounded shear flows have been carrried out. Both mass and heat transport have been experimentally studied. Statistical results for the temperature plume which develops from a line heat source at the wall are compared to the DNS results. The DNS results for this case and for the case of a uniform source with constant temperature boundaries are also compared to various model predictions.

6232 (CONF-930155–1) **Tests of random flight and closure models in predicting turbulent scalar transport.** Handler, R.A. (Naval Research Lab., Washington, DC (United States)); Rovelstad, A.L.; Bernard, P.S. Naval Research Lab., Washington, DC (United States); Maryland Univ., College Park, MD (United States). Dept. of Mechanical Engineering. Jan 1993. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-88ER13838. From PACAM 3; Sao Paolo (Brazil); Jan 1993. Order Number DE93004123. Source: OSTI; NTIS; GPO Dep.

The dispersal of contaminants in turbulent shear flows is an important concern in environmental science, meteorology and industrial processes. A number of approaches have been pursued in developing accurate means of predicting these phenomena, including traditional closure models applied to the Reynolds averaged transport equations, random flight models and probability density Junction methods. The development of DNS techniques for simulating turbulent dispersion provides a controlled means for studying the relative merits of diffusion algorithms in settings where all of the necessary fluid mechanical properties needed to implement the diffusion-calculations are available. The objective of this work is to describe a number of such tests which have been performed for turbulent dispersion in channel flow due to uniform and line sources.

6233 (DOE/ER/13764–10) **Internal structure and interfacial area in two-phase flow systems.** Kojasoy, G. Wisconsin Univ., Milwaukee, WI (United States). Dept. of Mechanical Engineering. [1991]. 121p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-87ER13764. (CONF-9110429–1: USA-USSR workshop on multiphase flow, Chicago, IL (United States), 2-4 Oct 1991). Order Number DE93000921. Source: OSTI; NTIS; GPO Dep.

The interfacial transfer terms and the importance of the interfacial area concentration are reviewed first with respect to the two-fluid model formulation of two-phase flow systems. Then the available measurement techniques for interfacial area are reviewed. At present, it appears that various methods such as the chemical, light attenuation, photographic, ultrasound attenuation and probe techniques have a number of limitations. Among these measurement techniques, however, the local probe method using one or more double sensors seems to have the greatest potential in terns of accuracy and wider applicability in various two-phase flow patterns. From the brief review of existing interfacial area modeling methods, it is concluded that the conventional approaches might not be sufficient, and new directions are indicated. Recent experimental results on local interfacial structural characteristics of horizontal bubbly two-phase flow and internal flow structure development are presented. More specifically, experimental results on local void fraction, interfacial area concentration, bubble size, bubble interface velocity and bubble frequency are documented in detail. Finally, a theoretical model predicting the mean bubble size and interfacial area concentration is proposed. The theoretically predicted bubble size and interfacial area concentration are found to agree reasonably well with those measured by using a double-sensor resistivity technique.

6234 (DOE/PC/90182–T7) **Studies of granular flow down an inclined chute: Quarterly technical progress report, 13 June 1992–12 September 1992.** Hanes, D.M. Florida Univ., Gainesville, FL (United States). [1992]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-91PC90182. Order Number DE93004936. Source: OSTI; NTIS; GPO Dep.

The driving force for the granular flow in the experimental region is gravity. The vehicle which re-circulates this flow is an 46 cm Corra-Trough belt conveyor manufactured by Buck-El, Inc. A drawing of this conveyor is shown in Figure 3. Entrance and exit chambers were designed to route the flow between the chute and the conveyor. Both devices had to be flexible because the position of the chute relative to the conveyor changes each time the angle of the chute is changed. Finally, to control the entering flow more accurately, an adjustable gate apparatus was constructed. The first step in setting up the chute is angle adjustment. The granular material used in the experiments described in this report are technical quality glass spheres, three millimeters in diameter. These beads are produced by Cataphote, Inc. Cataphote lists the tolerances for the 3mm spheres at ± 0.2 mm. The average mass of a single bead was measured to be 0.034 g which gives an average measured specific gravity of the glass at 2.42 g/cm^3.

6235 (DOE/PC/90185–T5) **[Kinetic theory and boundary conditions for flows of highly inelastic spheres: Applications to gravity driven granular flows down bumpy inclines]: Quarterly progress report, January 1, 1992–March 30, 1992.** Richman, M.W. Worcester Polytechnic Inst., MA (United States). [1992]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-91PC90185. Order Number DE93004935. Source: OSTI; NTIS; GPO Dep.

We studied the effects of isotropic boundary vibrations on unconfined granular materials that are compressed by gravity and dilated by the agitation of horizontal, vibrating boundaries. Because the vibrations are isotropic, the assemblies experience no mean motion. Consequently, the resulting boundary value problem is simpler than the boundary value problem that results when the vibrating surface is inclined. However, in both cases, we confront difficulties associated the occurrence of a free surface, and must implement recently derived boundary conditions for vibrating boundaries. We calculate the steady state solid fraction and granular temperature profiles throughout assemblies of identical, smooth, inelastic spheres that are unconfined from above and thermalized from below by bumpy, horizontal surfaces that randomly vibrate about zero mean velocity. The analysis is based upon a kinetic constitutive theory and conditions that account for the effects of boundary vibrations on the momentum and energy transferred to the spheres. In presenting the results, we pay special attention to the thermalized states of fixed masses subjected to varying boundary vibrations and varying masses subjected to fixed vibrations. In the first study, we find that as the vibration of the boundary intensifies, the assemblies of fixed mass become deeper, more dilute, and more thermalized. In the second, we find that as the assemblies become more massive, fixed boundary vibrations effectively thermalize decreasing fractions of the total mass.

6236 (DOE/PC/90185–T6) **[Kinetic theory and boundary conditions for flows of highly inelastic spheres: Application to gravity driven granular flows down bumpy inclines]: Quarterly progress report, April 1, 1992–June 30, 1992.** Richman, M.W. Worcester Polytechnic Inst., MA (United States). [1992]. 24p. Sponsored by USDOE, Washington, DC (United States). DOE

Contract AC22-91PC90185. Order Number DE93004934. Source: OSTI; NTIS; GPO Dep.

In this quarter, we extended our study of the effects of isotropic boundary vibrations to steady, gravity driven, inclined granular flows. These flows are more complex than those considered last quarter because of the presence of slip and mean velocity gradients at the boundary. Consequently, it was first necessary to modify the boundary conditions derived by Richman (1992) to account for corrections to the flow particle velocity distribution function from velocity gradients. In what follows we only summarize the results obtained.

6237 (DOE/PC/90185–T7) **[Kinetic theory and boundary conditions for flows of high inelastic spheres: Application to gravity driven granular flows down bumpy inclines]: Quarterly progress report, July 1, 1992–September 30, 1992.** Richman, M.W. Worcester Polytechnic Inst., MA (United States). [1992]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-91PC90185. Order Number DE93004933. Source: OSTI; NTIS; GPO Dep.

In this paper, we employ formal methods of statistical averaging to calculate the rates at which momentum and energy are transferred from anisotropically fluctuating bumpy boundaries to dense granular assemblies. The assemblies consist of identical, smooth, nearly elastic spheres that are thermalized by repeated collisions with the boundaries, but experience no mean motion as a consequence of these collisions. The boundaries vibrate with velocities that are governed by a tri-axial Gaussian distribution function that depends on both the normal and tangential mean square fluctuation speeds of the boundaries. Using the transfer rates calculated, we write down conditions that ensure that momentum and energy are balanced at such boundaries, and employ these conditions with a corresponding kinetic constitutive theory to analyze steady, gravity-free, thermalized states of granular assemblies between parallel, vibrating, bumpy boundaries. We find that, as the boundaries become bumpier, vibrations that are tangent the boundaries become more effective and vibrations that are normal to the boundaries become less effective at transferring energy to the assemblies.

6238 (GRS-TN-SRR–89-01) **CAST - a finite volume method for predicting two-dimensional flow and heat transfer phenomena.** Peric, M. (Erlangen-Nuernberg Univ., Erlangen (Germany). Lehrstuhl fuer Stroemungsmechanik); Scheuerer, G. Gesellschaft fuer Reaktorsicherheit mbH (GRS), Koeln (Germany). Sep 1989. 135p. Order Number DE93742625. Source: OSTI; NTIS (US Sales Only).

FORTRAN V.

The present report describes the computer program CAST for the Computer Aided Simulation of Turbulent Flows and its application to flow and heat transfer problems. CAST allows the calculation of recirculating (elliptic), two-dimensional (plane or axisymmetric), unsteady (or steady), low Mach number, laminar or turbulent flows with heat transfer. For laminar flows, CAST solves the Navier-Stokes equations. For turbulent flows, the Reynolds-averaged Navier-Stokes equations are solved in connection with the k-ϵ two-equation turbulence model of Launder and Spalding (1974). The numerical solution procedure is a conservative finite-volume method in primitive variables (i.e. velocities, pressure and enthalpy) using a co-located (non-staggered) variable arrangement. The program is written in FORTRAN V. This manual is intended for readers with a basic knowledge in fluid mechanics, numerical analysis and FORTRAN. Its purpose is to present the mathematical models for flow and heat transfer predictions, to convey the main elements of the numerical solution procedure, and to explain the structure and use of the computer program. (orig.).

6239 (IEN-DERE–01/86) **Validation of empirical formulas for estimation of flexible cylinders vibration maximum amplitude.** Brito Aghina, L.O. de; Cruz, J.R.B. Instituto de Engenharia Nuclear (IEN), Rio de Janeiro, RJ (Brazil). Dept. de Reatores. Jan 1986. [11] (In Portuguese). Order Number DE93609341. Source: OSTI; NTIS (US Sales Only); INIS.

A comparison is made between measurements performed in two experimental tests and the results predicted using empirical correlations for flexible cylinders maximum vibration amplitude. (L.C.J.A.).

6240 (KFK–4759) **Review of mathematical and physical basis of two-phase flow modelling.** Bottoni, M. (Argonne National Lab., IL (United States)); Sengpiel, W. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Reaktorsicherheit; Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Nukleare Sicherheitsforschung. Aug 1992. 165p. Order Number DE93750682. Source: OSTI; NTIS (US Sales Only); INIS.

Starting from a continuum-mechanical approach, this report gives a detailed overview of the deduction of conservation equations for the analytical description of two-phase flows by means of an adequate averaging process resulting in a two-fluid model and a homogeneous mixture model. The mathematical process of averaging leads to macroscopic formulations of stress terms and interfacial interaction terms. These terms depend on microscopic variables and thus give some helpful insight into the physical processes which have to be described by constitutive relations. (orig.).

6241 (KFK–5093) **Experiments on non-isothermal spreading.** Ehrhard, P. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Angewandte Thermo- und Fluiddynamik (IATF). Sep 1992. 46p. Order Number DE93744818. Source: OSTI; NTIS (US Sales Only); INIS.

Experiments are performed on axisymmetric spreading of viscous drops on glass plates. Two liquids are investigated: silicone oil (M-100) spreads to 'infinity' and paraffin oil spreads to a finite-radius steady state. The experiments with silicone oil partly recover the behaviour of previous workers data; those experiments with paraffin oil provide new data. It is found that gravitational forces dominate at long enough times while at shorter times capillary forces dominate. When the plate is heated or cooled with respect to the ambient gas, thermocapillary forces generate flows that alter the spreading dynamics. Heating (cooling) the plate is found to retard (augment) the streading. Moreover, in case of partial wetting, the finally-approached drop radius is smaller (larger) for a heated (cooled) plate. These data are all new. All these observations are in excellent quantitative agreement with the related model predictions of Ehrhard and Davis (1991). A breakdown of the axisymmetric character of the flow is observed only for very long times and/or very thin liquid layers. (orig.).

6242 (SAND–92-0885) **Finite element methods in heat transfer.** Gartling, D.K. Sandia National Labs., Albuquerque, NM (United States). Oct 1992. 172p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93006451. Source: OSTI; NTIS; GPO Dep.

The application of the finite element method to problems in conduction and convection heat transfer is described. The formulation of the basic equations is presented for nonisothermal, incompressible, viscous flows and nonisothermal flows in porous media; typical solution algorithms for both transient and time-independent problems are described. Example analyses are included for problems in heat conduction, forced convection and free convection.

4205 Materials Testing

Refer also to citation(s) 5206, 5801, 6033, 6036, 6264, 6267, 6406, 7252, 7287, 7294, 7336, 7337

6243 (ETDE-IT–92-97) **Potential alkali-reactivity of Torre Lago (Italy) sand.** Berra, M.; Mangialardi, T.; Paolini, A.E.; Pellorca, F. Ente Nazionale per l'Energia Elettrica, Milan (Italy). Centro di Ricerca Idraulica e Strutturale; Rome Univ. (Italy). 1991. 36p. (In Italian). Order Number DE93748438. Source: OSTI; NTIS (US Sales Only); INIS.

The potential alkali-reactivity of Torre Lago sand was evaluated by test methods directly based-on the aggregate (petrographic examination, infrared spectroscopy, X-ray diffraction analysis, chemical test ASTM C 289), or by mortar bar expansion tests (ASTM C 227, IN NaOH bath at 80 degrees C, saturated NaCl bath at 50 degrees C). Except for the ASTM C 227 method, all the test methods indicate that Torre Lago sand is a potentially deleterious aggregate from the view point of alkali-aggregate reaction. A critical examination of the results suggests that this sand is not deleterious when standard mortar bars are stored in water, as prescribed by Italian Standards for the evaluation of the mechanical

strengths of cements. Conversely, this sand could be deleterious when the cementitious mixes are to be exposed to particular environmental conditions, such as in the presence of de-icing salts.

6244 (ETDE-IT–92-98) **Critical evaluation of accelerated test methods for detecting alkali-reactivity of aggregates.** Berra, M.; Mangialardi, T.; Paolini, A.E.; Turriziani, R. Ente Nazionale per l'Energia Elettrica, Milan (Italy). Centro di Ricerca Idraulica e Strutturale; Rome Univ. (Italy). 1991. 37p. Order Number DE93748439. Source: OSTI; NTIS (US Sales Only); INIS.

The availability of high quality aggregates for concrete is often conditioned by increasingly restrictive environmental restraints. The limited availability of natural aggregates free of reactive minerals imposes the use of lower quality or not adequately tested aggregates, thus increasing the risk of alkali-aggregate reactions. This paper reports on the use of three accelerated test methods - infrared IR spectroscopy, mortar bar expansion tests in a 1 N NaOH bath at 80 degrees C, or in a saturated NaCl bath at 50 degrees C - to evaluate the potential reactivity of opal, fused silica, Nymolle and Torre Lago sands. Macro-crystalline quartz was used as a reference aggregate, and classical ASTM test methods were adopted as reference tests. It was found that the NaOH bath test method is the most suitable for evaluating the alkali reactivity of the aggregates tested, and that the mineralogical composition of the cement significantly affects the expansion level of mortar bars in both the NaOH and NaCl bath tests.

6245 (INIS-mf–14103) **Optimization of phased array probes for the inspection of nuclear components. Final report.** Wuestenberg, G. Bundesanstalt fuer Materialforschung und -pruefung, Berlin (Germany); Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Jul 1990 124p. (In German). Contract BMFT GRS 15007309. Order Number DE93750343. Source: OSTI; NTIS (US Sales Only); INIS.

Experience gained so far in local measurements on nuclear components shows that the development of ultrasonic test heads to the state where with group test heads in practical use, faults present in pressurized components with complex geometry can be successfully detected. The optimisation work carried out for this development, particularly on the shape of the radiator group (size and size distribution of the individual elements) and for the acoustic adaptation of the converter to the test object (multi-layer adaptation) are described in this report. In particular, a theoretical model of the sound field structure of group test heads and a theoretical model of the transmission behaviour of ultrasonic test heads have been developed to determine the shape of pulses for wide-band excitation. (orig.).

6246 (IS-M–727) **Using nonlinear acoustics for nondestructive materials characterization and evaluation.** Dace, G.E.; Buck, O.; Thompson, R.B. Ames Lab., IA (United States). [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-82. (CONF-921110–35: Winter annual meeting of the American Society of Mechanical Engineers (ASME), Anaheim, CA (United States), 8-13 Nov 1992). Order Number DE93004447. Source: OSTI; NTIS; GPO Dep.

A non-parabolic atomic potential explains a variety of acoustic observations such as stress effects on the sound velocity and acoustic harmonic generation. caused by a continuous distortion of the wave. Additional nonlinearities come about by alloying additions and by dislocation vibrations or. in other words. by the initiation of plastic flow. Particularly dramatic are the effects due to the nucleation of a new phase, as well as free and internal surfaces. These observations make nonlinear acoustics a valuable tool for nondestructive materials characterization, particularly since relative changes appear to be roughly an order of magnitude larger than those observed in traditional linear acoustics. Our work is concentrating on using acoustic harmonic generation as the primary measurement. We are developing a technique that measures displacement amplitudes using fluid-coupled contact transducers. First experiments on fused silica to test the system will be followed by the determination of solid solution effects of Cu in Al including the well-known precipitation sequences in this system during thermal aging.

6247 (JAERI-M–92-081) **Facility for stress corrosion cracking test of irradiated material in high temperature water.** Tsukada, Takashi (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Shiba, Kiyoyuki; Nakajima, Hajime; Kizaki, Minoru; Sudo, Kenji; Bell, G.E.C.; Ohmi, Masao; Goto, Ichiro. Japan Atomic Energy Research Inst., Tokyo (Japan). Jun 1992. 35p. (In Japanese). Order Number DE93753189. Source: OSTI; NTIS; INIS.

Irradiation assisted stress corrosion cracking (hereafter, IASCC) is a synergistic effect of neutron irradiation, aqueous environment and stress on nuclear core materials. In order to investigate the IASCC a facility for stress corrosion cracking test of irradiated materials was developed. The slow strain rate technique (SSRT) in high temperature and pressure water environment was employed. The post irradiation SSRT test facility consists of a SSRT test machine and a water circulation and purification system. In the design of the facility attentions were paid to safe and reliable remote operation of heavily irradiated materials in hot cell. Main specification of the facility is as follows; Maximum load capacity : 30 kN, Strain rate range : 10^{-7} s^{-1} $\approx$ 10^{-3} s^{-1}, Test temperature/pressure : 300degC and 10 MPa in maximum, Water supply rate : 5 l/h, Controllable range of dissolved oxygen (DO) : 0.01 $\approx$ 32 ppm. Water chemistry is monitored on DO, electric conductivity, and pH. Electrochemical potential and electric current are monitored and controlled on specimen. A preliminary test was carried out on the type 316 stainless steel irradiated up to 8 dpa in Oak Ridge Research Reactor under spectrally tailored condition. As a result of the test an occurrence of IASCC and a good performance of the facility were confirmed. (J.P.N.).

6248 (KCP–613-4677) **Nondestructive evaluation of ferrite c-cores: Final report.** Ekis, J.W. Allied-Signal Aerospace Co., Kansas City, MO (United States). Kansas City Div. Nov 1992. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00613. Order Number DE93004911. Source: OSTI; NTIS; GPO Dep.

A set of ultrasonic references for the ferrite c-cores for a stronglink safety component were designed and manufactured. Ten sets of references were made for both the primary and the secondary c-cores. One set of each will be used to inspect loose pieceparts. Second sets of each were mounted into transformer subassemblies. Third sets of each were mounted into transformers and welded into housing assemblies. These sets will be used to inspect their corresponding assemblies. All of these reference units were characterized using an ultrasonic test inspection system and calibrated by metrology. These reference units are now ready for use in product inspection.

6249 (SAND–91-2816C) **An impact technique to accelerate flier plates to velocities over 12 km/s.** Chhabildas, L.C. Sandia National Labs., Albuquerque, NM (United States). [1991]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-921162–11: Hypervelocity impact symposium, Austin, TX (United States), 17-20 Nov 1992). Order Number DE93002467. Source: OSTI; NTIS; GPO Dep.

Very high pressure and acceleration is necessary to launch flier plates to hypervelocities. In addition, the high pressure loading must be uniform, structured, and shockless, i.e., time-dependent to prevent the flier plate from either fracturing or melting. In this paper, a novel technique is described which allows the use of 100 GPa megabar loading pressures and 10^9-g acceleration to launch intact flier plates to velocities of 12.2 km/s. The technique has been used to launch nominally 1-mm thick aluminum, magnesium and titanium alloy plates to velocities over 10 km/s, and 0.5-mm thick aluminum and titanium alloy plates to velocities of 12.2 km/s.

6250 (SAND–92-2355C) **Hypervelocity impact tests and simulations of single Whipple bumper shield concepts at 10 km/s.** Chhabildas, L.C. (Sandia National Labs., Albuquerque, NM (United States)); Hertel, E.S.; Hill, S.A. Sandia National Labs., Albuquerque, NM (United States). [1992]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-921162–14: Hypervelocity impact symposium, Austin, TX (United States), 17-20 Nov 1992). Order Number DE93003999. Source: OSTI; NTIS; GPO Dep.

A series of experiments has been performed to evaluate the effectiveness of a Whipple bumper shield to orbital space debris at impact velocities of ~ 10 km/s. Upon impact by a 19 mm (0.87 nun thick, L/D ~0.5) flier plate, the thin aluminum bumper shield disintegrates into a debris cloud. The debris cloud front propagates axially at velocities of ~14 km/s and expands radially at a velocity of ~7 km/s. Subsequent loading by the debris on a 3.2 mm thick aluminum substructure placed 114 mm from the bumper penetrates the substructure completely. However, when the diameter of the flier plate is reduced to 12.7 mm, the substructure, although damaged, is not perforated over the duration of the experiment. Numerical simulations performed using the multi-dimensional hydrodynamics code CTH also predict complete perforation of the substructure by the subsequent debris cloud for the larger flier plate. The numerical simulation for a 12.7 mm flier plate, however, shows a strong dependence on assumed impact geometry, i.e., a spherical projectile impact geometry does not result in perforation of the substructure by the subsequent debris cloud, while the flat plate impact geometry results in perforation.

6251 (VTT-PUB–108) **Analysis of automated fatigue crack growth rate data.** Marquis, G. (Technical Research Centre of Finland, Espoo (Finland). Metals Lab.). Technical Research Centre of Finland, Espoo (Finland). 1992. 30p. Order Number DE93752853. Source: OSTI; NTIS.

Automated crack length measuring methods have largely replaced manual techniques in many applications. They require little operator time and have the additional feature of being able to collect large amounts of data. A method for compressing a large number of crack length observations into a smaller number of cock length estimates suitable for calculating the fatigue crack growth rate is described and verified using a simulation technique. With this method, the effective crack length measuring precision is improved and the amount of crack growth rate data obtainable from a single specimen is increased. Test times for threshold testing can also be potentially decreased. This method has been incorporated into a computer program, SAeRMAe, currently in use in VTT Metals Laboratory.

4210 Combustion Systems

Refer also to citation(s) 5349

6252 (DOE/METC/C–93/7050) **Pressure gain combustion.** Gemmen, R.S. (USDOE Morgantown Energy Technology Center, WV (United States)); Woodruff, S.D.; Richards, G.A.; Rogers, W.A. EG and G Washington Analytical Services Center, Inc., Morgantown, WV (United States). [1992]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC21-90MC26328. (CONF-921034–7: US Department of Energy contractors review meeting on coal-fueled heat engines, advanced PFBC and gas stream cleanup systems, Morgantown, WV (United States), 27-28 Oct 1992). Order Number DE93003494. Source: OSTI; NTIS; GPO Dep.

There are two primary objectives for this project. The first is to determine the pressure gain performance of pulse combustors, which is produced via the constant-volume type combustion, in conjunction with fluid mechanic diodicity. The second is to determine the high pressure operating characteristics of pulse combustors. During the course of investigation, it is expected that information on the scaling of pulse combustors will also be obtained. The information gained under this study will ultimately determine the practicability of using pulse combustors in gas turbine applications. This paper begins by presenting a simple thermodynamic analysis of a pulse combustor driven, gas-turbine system with the goal of evaluating the benefits of pressure gain combustion. The analysis is followed by a presentation of some current experimental and numerical results. The paper ends with a discussion of future work.

6253 (LBL–32927) **The effects of gravity on wrinkled laminar flames.** Kostiuk, L.W.; Zhou, L.; Cheng, R.K. Lawrence Berkeley Lab., CA (United States). Sep 1992. 13p. Sponsored by National Aeronautics and Space Administration, Washington, DC (United States). DOE Contract AC03-76SF00098. Contract C-32000-R. (CONF-9210213–1: 1992 Combustion Institute fall meeting of the western states section, Berkeley, CA (United States), 12-13 Oct 1992). Order Number DE93002572. Source: OSTI; NTIS; GPO Dep.

Laminar and turbulent conical Bunsen type flames were used. The study compares results from normal gravity with the burner in an up-right orientation (+g), the burner inverted (-g), and in microgravity (μg) by using the NASA Lewis drop tower facility. The primary diagnostic is a laser schlieren system and some LDA measurements were taken for the +g condition to measure the flow field. The +g laminar flame experiences a large amount of instabilities and results in an unsteady flame tip; cause is torroidal vortex rolling up between products and stagnate surrounding air. Comparison between LDA measurements in reactants and schlieren images shows that velocity fluctuation are induced at the same frequency as the roll up vortices are formed. This pumping of the reactant stream by the product/air interface instability in the +g case is also observed in the turbulent flames. In the -g arrangement the product/air interface is stable so there is no large pumping of the flame tip. At low flow rates the -g flames have flattened tips, but at higher flow rates they become conical in shape. When both flames. appear conical, the -g flames are longer for the same flow rate. In μg the larger instabilities in the flame no longer exist as the product/air interface is believed to become stable. The laminar flames in μg still show small instabilities over the entire flame.

4230 Marine Engineering

6254 (AUC-IBT-R–9204, pp. 75-84) **Springing response statistics of tension leg platforms.** Naess, A. (Department of Civil Engineering, Norwegian Institute of Technology, Trondheim (Norway)). Aalborg Universitetscenter (Denmark). Inst. for Bygningsteknik. Feb 1992. (CONF-9111281–: 2. Scandinavian forum for stochastic mechanics, Aalborg (Denmark), 21-22 Nov 1991). In *Scandinavian forum for stochastic mechanics.* 170p. Order Number DE93752802. Source: OSTI; NTIS.

The paper describes a method for estimating the statistics of second-order, sum-frequency forces and motions of tension leg platforms in random seas. The work is based on the assumption that these forces and motions can be characterized by a quadratic transfer funciton. A representation theorem for the second-order, sum-frequqncy force and response process is derived. (au) (10 refs.).

6255 (AUC-IBT-R–9204, pp. 85-94) **Prediction of extreme response of nonlinear structures by extended stochastic linearization.** Naess, A. (Department of Civil Engineering, Norwegian Institute of Technology, Trondheim (Norway)). Aalborg Universitetscenter (Denmark). Inst. for Bygningsteknik. Feb 1992. (CONF-9111281–: 2. Scandinavian forum for stochastic mechanics, Aalborg (Denmark), 21-22 Nov 1991). In *Scandinavian forum for stochastic mechanics.* 170p. Order Number DE93752802. Source: OSTI; NTIS.

The paper briefly describes a procedure for extending standard stochastic linearization to establish linearization methods that are better suited for the purpose of predicting extreme responses. The standard method of linearization applied to a nonlinear dynamic system is based on a mean square deviation measure to derive the 'equivalent' linear system. Experience indicates that the obtained linear system may have approximately the same mean square response as the original nonlinear system. For predicting extreme response this procedure is not, however, equally suitable. In the case of strong nonlinearities in the dynamic model, application of the standard method of linearization may lead to substantial overestimation of extreme responses. It is shown by example studies that the proposed methods may offer significant improvement in the ability to predict extreme responses. (au) (14 refs.).

6256 (AUC-IBT-R–9204, pp. 143-156) **Methods for estimation of extreme response of flexible risers.** Soedahl, N. (Norwegian Marine Technology Research Institute (Norway)); Larsen, C.M. Aalborg Universitetscenter (Denmark). Inst. for Bygningsteknik. Feb 1992. (CONF-9111281–: 2. Scandinavian forum for stochastic mechanics, Aalborg (Denmark), 21-22 Nov 1991). In *Scandinavian forum for stochastic mechanics.* 170p. Order Number DE93752802. Source: OSTI; NTIS.

This paper is focused on techniques for estimation of extreme response of flexible risers in a short-term environmental condition. It is shown that the degree of non-linearity is strongly system and excitation dependent and that conventional estimation techniques may introduce servere systematic errors. A new tail-fitting technique is found to give more precise extreme value estimates at the expense of an increased statistical uncertainty. A simple method for prediction of the simulation length required to obtain a specified level of confidence in the estimated extreme values is also presented. (au).

6257 (DTH-DCAMM–441) **A Bayesian inspection procedure applied to offshore steel platforms.** Juncher Jensen, J.; Terndrup Pedersen, P. Technical Univ. of Denmark, Lyngby (Denmark). Inst. of Mathematical and Operations Research. Apr 1992. 14p. Order Number DE93752739. Source: OSTI; NTIS.

Offshore structures are susceptible to fatigue damage due to the time varying hydrodynamic loads and the high stress levels. Therefore, in order to obtain a given high reliability of the structure, inspection schemes have to be formulated in order to keep track of crack initiation and crack growth. Usually the inspections and the subsequent repairs have to be done on-site, requiring a skilled work-force and expensive man-hours. It is therefore important to optimize the intervals between the inspections, the number of joints inspected and the amount of repair work. In the present paper a Bayesian approach is taken, following a procedure originally suggested by Itagaki and Shinozuka. Here the statistical distributions of some of the parameters in the crack initiation, crack detection and crack propogation are updated at each inspection and used to derive better estimates for the number of severe cracks as function of time until the next inspection. Thereby it is possible to decide on an appropriate interval to the next inspection taking into account both the cost of the inspection and the cost of repairing the severe cracks. As an example, a jack-up operating in the North Sea is chosen. Inspection data for 3 consecutive inspections of several joints close to the lower guides are available. Based on an analysis of these results the implementation and usefulness of the present Bayesian approach is discussed. (Author).

6258 (NEI-NO–302) **Modeling and control of underwater vehicles: A Lagrangian approach.** Sagatun, S.I. Trondheim Univ. (Norway). Norges Tekniske Hoegskole. Mar 1992. 192p. Order Number DE93752999. Source: OSTI; NTIS.

This thesis contains an extensive study of modeling and control of underwater vehicles. The thesis concludes that there will be an emerging demand for more optimal and advanced nonlinear controllers for underwater vehicles. Minimum control effort controllers will be especially needed. Lagrangian dynamics has successfully been employed to derive the equations of motion for underwater vehicles. The Lagrangian approach in modeling exposes the properties of the underwater vehicles' equation of motion in a way that the more traditional Newtonian approach does not. The expressions for energy and work used in the Lagrangian mechanics are also useful in control system design when stability and optimality are proved by using nonlinear stability theory. The equations of motion are derived in both an inertial reference-frame and a vehicle-fixed coordinate system. Results from open-water tests of the Norwegian Experimental Remotely Operated Vehicle's (NEROV) thruster system are presented. These test-results show the nonlinear relation between the vehicle's velocity and thrust. Test results from free-decay tests of the NEROV are also presented. These results show how the vehicles added inertia and damping coefficients vary as a function of the Keulegan-Carpenter number. These parameters' dependencies of frequency and a perturbed vehicle geometry are also investigated. These tests clearly show that the model parameters of underwater vehicles are time-varying. Two optimal and near-optimal nonlinear controllers are derived in minute detail. Both controllers are optimal in the sense that they minimize the generalized forces that correspond to the vehicle's kinetic energy and the energy which dissipate from the vehicle. 126 refs., 41 figs., 7 tabs.

4260 Components, Electron Devices and Circuits

Refer also to citation(s) 5065, 5734, 5825, 6094, 6204, 6287, 6301, 6346, 6386, 6428, 6429, 6430, 6454, 6455, 6459, 7136, 7401, 7499

6259 (CONF-921101–11) **Covalent nitrides for maskless laser writing of microscopic metal lines.** Maya, L. Oak Ridge National Lab., TN (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Material Research Society fall meeting; Boston, MA (United States); 30 Nov - 5 dec 1992. Order Number DE93004105. Source: OSTI; NTIS; GPO Dep.

Selected covalent metal nitrides with limited thermal stability, such as Sn_3N_4, Cu_3N, and Ni_3N, were prepared in a glow discharge system by reactive sputtering in a nitrogen plasma. These compounds were characterized by chemical analysis and their thermal behavior established by temperature-programmed thermal decomposition. These materials decompose into the elements with the rate reaching a maximum at 615, 465, and 405°C for Sn, Cu, and Ni respectively. The feasibility of using these coatings to generate metal lines by maskless laser writing was explored. Conducting metal lines, a few micron in width, could be generated with each of these nitrides. The resistivities of the metal lines were within an order of magnitude of those of the bulk metals for Cu and Ni and somewhat more for Sn.

6260 (DOE/CE/27504–9) **Variable frequency drive applications guide.** Laloudakis, D.J. Urban Consortium for Technology Initiatives (United States). Energy Task Force; Public Technology, Inc., Washington, DC (United States); Phoenix Public Works Dept., AZ (United States). Energy Conservation Div. Oct 1991. 71p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90CE27504. Order Number DE93005615. Source: OSTI; NTIS; GPO Dep.

Traditionally, fans and pumps have been designed to be capable of handling the maximum demand of the system in which they are installed. However, quite often the actual demand can vary and it can be much lower than the original design capacity. These situations have been corrected in the past through additions of outlet dampers to fans or throttling valves to pumps. While these can be effective and simple controls they severely affect the efficiency of the system. Variable frequency (speed) is the most efficient means of capacity control. The most cost effective method of achieving variable speed capacity control is using AC adjustable frequency drives. AC adjustable frequency controls convert any fixed speed AC motor into an adjustable speed device. Adjusting the speed of a motor, by controlling the frequency of the AC power to that motor, reduces its horsepower requirements. According to pump and fan laws, capacity is proportional to speed while horsepower is proportional to the cube of the speed. Therefore, by reducing the speed of an AC motor by 20 percent the horsepower requirement is reduced by nearly 50 percent. Reduced speed through variable frequency control allows for flexibility of meeting changing weather and comfort requirements without operating costly equipment at full capacity.

6261 (DOE/ER/12108–2) **Molecular design concept for x-ray laser research: Progress report, 15 December–30 September 1992.** Rhodes, C.K.; Luk, T.S.; McPherson, A.; Boyer, K. Illinois Univ., Chicago, IL (United States). Lab. for Atomic, Molecular, and Radiation Physics. 10 Dec 1992. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER12108. Order Number DE93004561. Source: OSTI; NTIS; INIS; GPO Dep.

The goal of this program is the construction of an x-ray laser in the kilovolt regime. Recent experimental results indicate that a new technique for the generation of strong amplification of x-ray wavelengths is feasible. It involves the combination of (1) a new ultrahigh brightness subpicosecond laser technology and (2) a recently discovered unique mode of strong-field interaction, particularly applicable to molecules. A concept of molecular x-ray design emerges from the considerations which matches the mode of excitation to the structure of the molecular system. The molecular approach enables the combination of very highly electronically excited conditions with an environment characteristic of dense cold

matter, a general situation exceptionally conducive to x-ray amplification. Both high efficiency and wavelength tunability are intrinsic features of this method. Recent results discussed in this report are revealing important characteristics of the molecular strong-field coupling pertinent to this goal. A continued program of research is proposed to evaluate this method for the production of x-ray amplification in the kilovolt region.

6262 (ETDE/JP-mf–93753763, pp. 480-498) **SQUID. Part 2.: Application of SQUID.** Yamashita, T. (The Technical University of Nagaoka, Niigata (Japan)). Cryogenic Association of Japan, Tokyo (Japan). [1991]. 606p. (In Japanese). In *Proceedings of the 1st-4th cryogenic engineering summer seminar (1988-1991).* Order Number DE93753763. Source: OSTI; NTIS (US Sales Only).

The present report explained the application of Josephson device to electronics. As compared with the semiconductor device, the device can operate at high speed however with a very small power consumption and transfer the signal also at high speed without distortion. Characteristics excelling in reproducibility are given by the Josephson device which uses an Nb electrode/Al_2O_3 barrier/Nb electrode. By a superconducting quantum interference device (SQUID) using the Josephson device, a four-bit microprocessor was prototypically made with success to operate at 4.2K. Against the silicon and GaAs which are 33ns and 14ns, respectively in operation time for one sequence, the Josephson device is 1.3ns in it, which is shorter by one digit than the semiconductor. Also prototypically made by using the same materials, a 1K-bit memory demonstrated a superhigh speed where the reading time was 0.57ns. There are many already published studies of monocrystalline thin film which is a high temperature superconductor device of good characteristics. However in order to structure such a device as the SQUID, it is necessary to develop the materials of substrate and barrier which are appropriate for it. 9 refs., 19 figs., 2 tabs.

6263 (KCP–613-4865) **Vacuum multilayer lamination of printed wiring boards.** Wilkus, J.W. Allied-Signal Aerospace Co., Kansas City, MO (United States). Kansas City Div. Nov 1992. 119p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00613. Order Number DE93004912. Source: OSTI; NTIS; GPO Dep.

This experiment investigates vacuum multilayer lamination of rigid/flex, epoxy glass, polyimide glass, and polyimide quartz printed wiring boards. The effectiveness of the vacuum in removing entrapped air during the lamination cycle is demonstrated. The results of the experiment have also shown that vacuum lamination of epoxy glass multilayers improves the delamination resistance. Thus, epoxy glass multilayers that have been vacuum laminated will be able to withstand soldering temperatures longer without delaminating. Also, the experiment shows that vacuum multilayer lamination does not significantly change thickness, layer-to-layer registration, glass transition temperature, dielectric spacing between conductors, electrical resistance following thermal shock test, and other critical printed wiring board properties.

6264 (KCP–613-4869) **Automated connector force testing: Final report.** Timmons, L.A. Allied-Signal Aerospace Co., Kansas City, MO (United States). Kansas City Div. Nov 1992. 50p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00613. Order Number DE93004634. Source: OSTI; NTIS; GPO Dep.

A gaging system was developed to modernize the force testing of electrical connectors and components using an IBM personal computer based data acquisition system. Two mechanical fixtures were fabricated using load cells and LVDT transducers to perform the measurements. General purpose software routines perform the operator interface, data acquisition, storage, retrieval, and printout. The system will perform statistical analysis of the part data to aid in evaluation of the manufacturing process. The modular software concept allows the system to be tailored for many other applications using a text editor.

6265 (KCP–613-4968) **Microelectronics packaging automation: Final report.** Blazek, R.J. Allied-Signal Aerospace Co., Kansas City, MO (United States). Kansas City Div. Nov 1992. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00613. Order Number DE93004822. Source: OSTI; NTIS; GPO Dep.

Microelectronic packaging evaluations were completed that established process capabilities for wire bond testing data analysis, eutectic die attach, and hermetic sealing. These processes are used for chip and wire hybrid microcircuits (HMCs), leadless chip carriers (LCCs), and large-scale integrated circuits (LSIs) manufactured at the Kansas City Division.

6266 (LA-UR–92-3231) **Modeling the APLE injector solenoid magnetic field with the Biot-Savart Law.** Takeda, Harunori (Los Alamos National Lab., NM (United States)); Dowell, D. Los Alamos National Lab., NM (United States). [1992]. 23p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9208142–15: 14. international free electron laser conference, Kobe (Japan), 23-28 Aug 1992). Order Number DE93003695. Source: OSTI; NTIS; GPO Dep.

The APLE (Average Power Laser Experiment) photoinjector accelerates electrons to 5 MeV with four cavities. A solenoid placed between the first two cavities focuses the low energy (1.2 MeV) electron beam. The beam transport and the beam quality of the injector depend on the detailed field profile of the solenoid. To describe the solenoid magnetic field accurately, we integrate the fields from each section of the solenoid using the Biot-Savart's Law. This integration can produce an accurate model of the solenoid field installed in the APLE injector. The solenoid consists of three layers with a shared axis. Each layer is connected by spirals, and the ends are terminated with the leads. We evaluate the magnetic field from each component of solenoid and study the asymmetric transverse field along the beam axis that was observed in the experiment. We determine the angle of the solenoid axis by a best match of transverse field components measured on the beam axis z.The Biot-Savart algorithm is implemented in the particle simulation code PARMELA, and the injector optimization was performed.

6267 (LA-UR–92-3649) **Design and characterization of the Pegasus I plasma flow switch.** Wysocki, F.J. (Los Alamos National Lab., NM (United States)); Bartsch, R.R.; Bowers, R.L.; Cochrane, J.C.; Greene, A.E.; Ladish, J.S.; Lee, P.H.Y.; Parker, J.V.; Peterson, D.L.; Benage, J.F.; Gribble, R.F.; Shlachter, J.S.; Scudder, D.W.; Roderick, N.F.; TLos Alamos National Lab., NM (United States). [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-921133–6: 6. international conference on megagauss magnetic field generation and related topics, Albuquerque, NM (United States), 9-12 Nov 1992). Order Number DE93003812. Source: OSTI; NTIS; GPO Dep.

A plasma flow switch (PFS) based on an experimental design utilized at the Air Force Weapons Laboratory (AFWL) has been fielded on the Pegasus I system. Currents of as much as 5.8 MA have been switched on a time scale (10–90%) of 200 ns into a static load. Tests with a foil load have resulted in a less than ideal current transfer because of interaction between the dynamic load and the plasma flow switch. Two-dimensional radiation magnetohydrodynamic (RMHD) calculations have been used to characterize the behavior of the PFS and to aid in the design. These calculations have also been used to investigate several classes of perturbations in the switch-plasma, the interaction of the switch-plasma with the coaxial electrodes, and their effect on switching efficiency. The Pegasus I PFS experiments reproduce the results obtained at AFWL throughout the switch initiation and switching phases. However, early in the foil implosion the switched current drops significantly. We believe this current drop results from a small amount of residual plasma left behind in the PFS region that impedes the magnetic-flux transport, thereby preventing efficient foil implosion. The experimental results suggest that the method of PFS initiation (viz. chordal wire arrays) may be an important factor in switch operation.

6268 (SAND–92-1906C) **Analysis and measurement of thermal resistance in a 3-dimensional silicon multichip module populated with assembly test chips.** Sweet, J.N.; Peterson, D.W.; Chu, D.; Bainbridge, B.L.; Gassman, R.A.; Reber, C.A. Sandia National Labs., Albuquerque, NM (United States). 2 Sep 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930233–1: 9. annual Institute

of Electrical and Electronic Engineers (IEEE) semiconductor thermal measurement symposium, Austin, TX (United States), 2-4 Feb 1993). Order Number DE93000743. Source: OSTI; NTIS; GPO Dep.

Three dimensional multichip modules (MCMS) present an unusual challenge to the thermal designer. For example, high thermal resistance between upper planes of the MCM and the thermally anchored bottom plane can lead to the development of excessive temperatures. As new designs emerge, it becomes desirable to have methods of experimentally determining interior temperatures in the module in order to validate complex finite element calculations. In order to develop methods for assessing the thermal performance of a 3D MCM, we have developed a test module with three planes or slices. In this paper, we report on some initial calculations and measurements for the 3D MCM. In addition, we discuss the improvement in thermal performance obtained by replacing the top slice with a diamond substrate. Finite element method (FEM) thermal calculations have been done with both the workstation based analyzer P/Thermal from PDA Engineering and the PC program, Inertia from Modern Computer Aided Engineering. These analyses have assumed no heat losses by radiation or convection.

6269 (SAND–92-2073C) **Analysis of parametric drift of a MESFET-based GaAs MMIC due to 125°C storage.** Dreike, P.L.; Barton, D.L.; Sandoval, C.E. Sandia National Labs., Albuquerque, NM (United States). [1992]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930354–1: International reliability physics conference, Atlanta, GA (United States), 22-25 Mar 1993). Order Number DE93000715. Source: OSTI; NTIS; INIS; GPO Dep.

Microwave parameters drifted significantly for two out of twenty-nine GaAs MESFET-based MMICs during ten weeks of storage at 125°C and 150°C. Analysis using measured, post- storage, FET characteristics and the microwave behavior indicates that all of the FETs in the MMICs drifted, most likely due to contamination.

6270 (SAND–92-2434C) **Effects of simulated storage on the solder wettability of inhibited substrates.** Hosking, F.M.; Sorensen, N.R. Sandia National Labs., Albuquerque, NM (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930242–1: National Electronic Packaging in Production (NEPCON) west conference, Anaheim, CA (United States), 9 Feb 1993). Order Number DE93004042. Source: OSTI; NTIS; GPO Dep.

Solder wettability of Class II environmentally exposed Cu substrates coated with an organic solderability preservative (OSP) is being investigated. The OSP coatings slightly retarded the wetting behavior of 60Sn-40Pb solder during baseline testing of unaged coupons. A nominal increase in wetting angle, or decrease in wettability, was observed on the inhibited surfaces, particularly when less active fluxes were used. Small increases in the wetting time and decreases in the wetting rate were also measured. Simulated accelerated aging tests are underway to determine the effects of aging in a typical indoor industrial environment on the solder wettability of OSP coated Cu.

6271 (UCRL-JC–108124) **Examination of laser conditioning using atomic force microscopy.** Tesar, A.; Balooch, M.; Tench, R.; Stolz, C.; Sarginson, T.; Siekhaus, W. Lawrence Livermore National Lab., CA (United States). Jan 1992. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-911064–11: SPIE International Society for Optical Engineering meeting, Boulder, CO (United States), 23-25 Oct 1991). Order Number DE93001328. Source: OSTI; NTIS; GPO Dep.

The modification of an optical coating surface with laser exposure at fluences below the damage threshold resulted in localized minimization of asperities. Topological changes with time were mapped using an atomic force microscope. It is suggested that charge accumulation on the dielectric coating drives the surface morphology to higher uniformity.

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Refer also to citation(s) 5730

6272 (INIS-GB–454) **Daresbury 1991/92.** Daresbury Lab. (United Kingdom). 1992[68] Order Number DE93609366. Source: OSTI; NTIS (US Sales Only); INIS.

The report gives an overview of the activities over the year 1991/92. There are more than 4000 registered uses of the facilities at Daresbury so only the highlights can be included. The largest programme is that centred on the Synchrotron Radiation source. During the year this was shut down so that a second superconducting wiggler magnet could be installed. The smallest programme is that associated with Theory, Computational Science and Computing. Collaboration between the Medical and the Science and Engineering Research Councils reflects the interest of both in structural biology. A feasibility study for an Advanced Proton Source has been undertaken as part of the long-term planning for the laboratory. The work on EUROGAM, a Joint UK/France Gamma-Ray Detector is reported. A list of publications of scientists using the facilities at the laboratory is included. Separate appendices are available on the SRS, NSF (Nuclear Structure) and the Theory, Computational Science and Computing facilities. (UK).

6273 (INIS-GB–455) **Synchrotron radiation: Appendix to the Daresbury annual report 1991/92.** Seddon, E.A.; Reid, R.J. (comps.). Daresbury Lab. (United Kingdom). 1992[325] Order Number DE93609367. Source: OSTI; NTIS (US Sales Only); INIS.

Work at the Daresbury SRS has of necessity been interrupted this year (1991/92) due to the incorporation of Wiggler II. However, considerable beamtime was awarded before the shutdown and the major part of this appendix is concerned with the progress reports of the research undertaken then. The reports have been organised under the following broad headings: Molecular Science (19 papers), Surface and Materials Science (169 papers), Biological Science (85 papers), Instrumental and Technique Developments (13 papers) and Accelerator Physics (3 papers). It is hoped that in time the number of contributions on accelerator physics will grow to reflect the in-house activity on, for example, accelerator improvement and design. The research reports are preceded by the Annual Report of the Synchrotron Radiation Facilities Committee, which outlines the research highlights identified by that Committee (also included are details of the current membership of the SRFC and the chairmen of the Beamtime Allocation Panels). Following the reports are the specifications for the beamlines and stations. This year Section 3 contains 289 reports (nearly 100 more than last year) and the number of publications, generated by scientists and engineers who have used or are associated with Daresbury Laboratory facilities, has topped 500 for the first time. (author).

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Refer also to citation(s) 4907, 6925, 6991, 7373, 7456, 7484

6274 (ANL/CP–76391) **Review of superconducting ion linacs.** Bollinger, L.M. Argonne National Lab., IL (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9208109–67: 16. international LINAC conference, Ottawa (Canada), 23-28 Aug 1992). Order Number DE93002992. Source: OSTI; NTIS; INIS; GPO Dep.

This paper summarizes the status of the technology of superconducting (SC) linacs designed for the acceleration of ions. The emphasis is on the technical issues involved, with only brief descriptions of the numerous linacs now in operation or under construction. Recent developments of special interest are treated in more detail, and remaining technical challenges are outlined. The technology required for the acceleration of ions with velocity β=1 is not discussed because it is almost the same as for relativistic electrons. That is, this paper is mainly about SC linacs for low-velocity heavy ions.

6275 (BNL–34518-Ed.8) **AGS Experiments: 1989, 1990, 1991.** Depken, J.C. Brookhaven National Lab., Upton, NY (United States). Feb 1992. 160p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE93002937. Source: OSTI; NTIS; INIS; GPO Dep.

This report contains: Experimental areas layout; table of beam parameters and fluxes; experiment schedule "as run"; proposed

1992 schedule; a listing of experiments by number; two-page summaries of each experiment begin here, also ordered by number; publications of AGS Experiments begin here; and list of AGS Experimenters begins here.

6276 (CONF-920837–24) **A new concept for an asymmetric Φ factory to test CPT and study K_s^0 mesons.** Cline, D.B. California Univ., Los Angeles, CA (United States). Center for Advanced Accelerators Physics. [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-91ER40662. From ICHEP-26: 26th International Union of Pure and Applied Physics (IUPAP) conference on high energy physics; Dallas, TX (United States); 6-12 Aug 1992. Order Number DE93003033. Source: OSTI; NTIS; INIS; GPO Dep.

We propose a new type of e^+e^- collider with approximately colinear beams that interact at small angles to produce energetic mesons and K_s^0, K_L^0 beams. We apply this concept to the collision of a 2 GeV e^- linear accelerator and a compact 1 GeV e^+ storage ring and show how high luminosity operation might be achieved as well as a crab crossing geometry. We discuss the experimental advantages of this scheme for producing energetic K_s^0 beams and $\phi \rightarrow K_S K_L$ interference compared to conventional ϕ factories.

6277 (CONF-9209206–4) **Radioactive ion beam production challenges at the Holifield Heavy Ion Research Facility.** Meigs, M.J.; Alton, G.D.; Dowling, D.T.; Haynes, D.L.; Jones, C.M.; Juras, R.C.; Lane, S.N.; Mills, G.D.; Mosko, S.W.; Olsen, D.K.; Tatum, B.A. Oak Ridge National Lab., TN (United States). [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Symposium of northeastern accelerator personnel (SNEAP); Quebec (Canada); 23-25 Sep 1992. Order Number DE93003609. Source: OSTI; NTIS; INIS; GPO Dep.

The radioactive ion beam (RIB) project at the Holifield Heavy Ion Research Facility (HHIRF) will provide for reconfiguration of the HHIRF accelerator system to enable provision of low-intensity RIBs for nuclear and astrophysics research. As we have progressed with the design of the reconfiguration, we have encountered several challenges that were not immediately obvious when first contemplating the project. The challenges do not seem insurmountable but should keep life interesting for those of us doing the work. A brief review of the project will allow a better understanding of the challenges in RIB production. Radioactive ion beams will be produced with the Isotope Separator On-Line (ISOL) postacceleration technique. In particular, radioactive atoms will be produced by reactions in the thick stopping target of an ISOL-type target-ion source assembly using intense beams from the Oak Ridge Isochronous Cyclotron equipped with a light-ion internal source. This ISOL target-ion source assembly will be mounted on a high-voltage platform with a mass separator. The target ion source will operate at potentials up to 50 kV with respect to the high voltage platform. The radioactive atoms produced by nuclear reactions in the target diffuse to the surface of the heated target material, desorb from this surface, and effuse through a heated transfer tube into an ion source where ionization and extraction take place. Two types of ion sources will be initially considered. A Forced Electron Beam Induced Arc Discharge source, similar to those used by the ISOLDE facility at CERN and by the UNISOR facility at ORNL, will be built to produce positive ions. These positive ions will be focused through an alkali vapor charge-exchange canal to produce negative ions for tandem injection. In addition, a direct negative surface ionization addition or modification to the above source will be built and investigated.

6278 (IEN–29/91) **Activation study of the cyclotron CV-28 component parts.** Fajardo, P.W. Instituto de Engenharia Nuclear (IEN), Rio de Janeiro, RJ (Brazil). Nov 1991. [34] (In Portuguese). Order Number DE93609372. Source: OSTI; NTIS (US Sales Only); INIS.

The objective of this paper is to find out the possible nuclear reactions of the accelerated particles with the Cyclotron component parts during normal operation in order to know the produced by activation. This enables the implementation of suitable radiation protection procedures. (author).

6279 (INP–1467/PS, pp. 161-177) **Nuclear physics techniques of Eindhoven University of Technology (EUT), the Netherlands.** Voigt, M.J.A. de (Technische Univ. Eindhoven (Netherlands)). Institute of Nuclear Physics, Cracow (Poland); Uniwersytet Jagiellonski, Cracow (Poland). Inst. Fizyki. 1989. (CONF-8904247–: 24. Zakopane school on physics, Zakopane (Poland), 16-30 Apr 1989). In *Proceedings of 24. Zakopane school on physics, Zakopane, Poland, 16-30 April 1989. Part 2: Condensed matter studies by nuclear methods.* [389] Order Number DE92637345. Source: OSTI; NTIS (US Sales Only); INIS.

The activities of the group "Nuclear Physics Techniques" of the Department of Technical Physics of Eindhoven University of Technology are presented. The ILEC, 3 MeV isochronous low-energy cyclotron for protons and the EUTERPE, ring for 400 MeV electrons and 80 MeV protons are described. A short information on elemental analysis, radionuclides production, laser applications and detectors is also given. (A.S.).

6280 (INS-T–507) **Research and education by SF cyclotron facility.** Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Apr 1992. 51p. (In Japanese). Order Number DE93753135. Source: OSTI; NTIS; INIS.

This report represents the current activities in research and education using the cyclotron facility and related apparatus which are supported by Nuclear Physics Division and this is a continuation of INS-T-466 (1986, December). In this version an iron-free β-ray spectrometer and a cooler-synchrotron (TARN II) are briefly described also in the first chapter. The second chapter explains experimental programs performed in the last 5 years. The third chapter gives the number of publications on researches performed in 1975-1991, and also gives twelve topics obtained from the cyclotron and the β-ray spectrometer in recent 5 years. The last chapter provides the whole list of the works for Doctor and Master theses performed at the facility in the last 10 years. (J.P.N.).

6281 (JAERI-M–92-138) **Report of the third seminar on nuclear physics at the energy region of the JAERI tandem-booster accelerator February 27-28, 1992, Tokai, Japan.** Iwamoto, Akira (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Oshima, Masumi; Ikezoe, Hiroshi; Nagame, Yuichiro; Shinohara, Nobuo. Japan Atomic Energy Research Inst., Tokyo (Japan). Sep 1992. 121p. (In Japanese, English). Order Number DE93754330. Source: OSTI; NTIS; INIS.

A seminar on new experiments to be studied and new experimental apparatus suitable for the JAERI tandem-booster accelerator being under construction was held at Tokai Research Establishment of JAERI in the period from February 27 to 28, 1992. Sixty eight participants from universities and from JAERI attended to discuss the following items: 1. Physics at low temperature, 2. Nuclear structure at high spin and at high excitation energy, 3. Application of unstable beam and their spectroscopy, 4. Nuclear reaction at intermediate energy, 5. New facilities. (author).

6282 (LA-UR–92-3438) **Limited-scope probabilistic safety analysis for the Los Alamos Meson Physics Facility (LAMPF).** Sharirli, M.; Rand, J.L.; Sasser, M.K.; Gallegos, F.R. Los Alamos National Lab., NM (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930116–14: Probabilistic safety assessment international topical meeting (PSA 93), Clearwater Beach, FL (United States), 27-29 Jan 1993). Order Number DE93003705. Source: OSTI; NTIS; GPO Dep.

The reliability of instrumentation and safety systems is a major issue in the operation of accelerator facilities. A probabilistic safety analysis was performed or the key safety and instrumentation systems at the Los Alamos Meson Physics Facility (LAMPF). in Phase I of this unique study, the Personnel Safety System (PSS) and the Current Limiters (XLs) were analyzed through the use of the fault tree analyses, failure modes and effects analysis, and criticality analysis. Phase II of the program was done to update and reevaluate the safety systems after the Phase I recommendations were implemented. This paper provides a brief review of the studies involved in Phases I and II of the program.

6283 (LA-UR–92-3441) **Simultaneous operation of a free-electron laser on two harmonically related wavelengths.** Burke, A.T. (California Univ., San Diego, La Jolla, CA (United States). Dept. of Physics); Ride, S.K.; Schmitt, M.J.; Goldstein, J.C. Los

Alamos National Lab., NM (United States). [1992]. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9208142–14: 14. international free electron laser conference, Kobe (Japan), 23-28 Aug 1992). Order Number DE93003745. Source: OSTI; NTIS; INIS; GPO Dep.

The interaction of light waves at the fundamental and the third harmonic frequencies in a free-electron laser (FEL) oscillator is explored using the 1-D finite pulse mode-code BFELP. The code, which assumes that only the TEM_{00} transverse mode is present at both harmonic frequencies, tracks the temporally-finite pulse electric field amplitudes of the fundamental and the third harmonic which interact with an rf-linac-generated electron micropulse inside a wiggler. The evolution of the pulse profiles, with possibly different mirror reflectivities at each frequency, after many passes through the wiggler and the optical resonator, has been generated for various initial conditions. Results include pulse-dependent third-harmonic coherent-spontaneous emission (CSE) with, and without, multiple-pass interference effects; the effects of sidebands at the fundamental on third-harmonic CSE; and, lasing competition between the fundamental and third harmonic in overlapping spatial regions of the electron micropulse.

6284 (LA-UR–92-3519) **Probabilistic risk assessment for the Los Alamos Meson Physics Facility worst-case design-basis accident.** Sharirli, M. (Los Alamos National Lab., NM (United States)); Butner, J.M.; Rand, J.L.; Macek, R.J.; McKinney, S.J.; Roush, M.L. Los Alamos National Lab., NM (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-930116–13: Probabilistic safety assessment international topical meeting (PSA 93), Clearwater Beach, FL (United States), 27-29 Jan 1993; N–6-92-R197). Order Number DE93003755. Source: OSTI; NTIS; INIS; GPO Dep.

This paper presents results from a Los Alamos National Laboratory Engineering and Safety Analysis Group assessment of the worse-case design-basis accident associated with the Clinton P. Anderson Meson Physics Facility (LAMPF)/Weapons Neutron Research (WNR) Facility. The primary goal of the analysis was to quantify the accident sequences that result in personnel radiation exposure in the WNR Experimental Hall following the worst-case design-basis accident, a complete spill of the LAMPF accelerator 1L beam. This study also provides information regarding the roles of hardware systems and operators in these sequences, and insights regarding the areas where improvements can increase facility-operation safety. Results also include confidence ranges to incorporate combined effects of uncertainties in probability estimates and importance measures to determine how variations in individual events affect the frequencies in accident sequences.

6285 (LA-UR–92-3662) **Bridge coupled drift tube linacs.** Liska, D.; Smith, P.; Carlisle, L.; Larkin, T. Los Alamos National Lab., NM (United States). [1992]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-921116–17: 12. international conference on the application of accelerators in research and industry, Denton, TX (United States), 2-5 Nov 1992). Order Number DE93003815. Source: OSTI; NTIS; GPO Dep.

Modern linac designs for treating radioactive waste achieve high proton currents through funneling at low energy, typically around 20 MeV. The resulting switch to a high-frequency accelerating structure poses severe performance and fabrication difficulties below 100 MeV. Above 100 MeV. proven coupled-cavity linacs (CCLS) am available. However, at 20 MeV one must choose between a high-frequency drift-tube linac (DTL) or a coupled-cavity linac with very short cells. Potential radiation damage from the CW beam, excessive RF power losses, multipactoring, and fabricability all enter into this decision. At Los Alamos, we have developed designs for a bridge-coupled DTL (BCDTL) that. like a CCL, uses lattice focusing elements and bridge couplers, but that unlike a CCL, accelerates the beam in simple. short, large-aperture DTL modules with no internal quadrupole focusing. Thus, the BCDTL consumes less power than the CCL linac without degrading beam performance and is simpler and cheaper to fabricate in the 20 to 100 MeV range.

6286 (LBL–32182) **Design of a superconducting linear accelerator for an Infrared Free Electron Laser of the proposed Chemical Dynamics Research Laboratory at LBL.** Chattopadhyay, S.; Byrns, R.; Donahue, R.; Edighoffer, J.; Gough, R.; Hoyer, E.; Kim, K.J.; Leemans, W.; Staples, J.; Taylor, B.; Xie, M. Lawrence Berkeley Lab., CA (United States). Aug 1992. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (ESG–177;CONF-9208109–69: 16. international LINAC conference, Ottawa (Canada), 23-28 Aug 1992). Order Number DE93004688. Source: OSTI; NTIS; GPO Dep.

An accelerator complex has recently been designed at LBL as part of an Infrared Free Electron Laser facility in support of a proposed Chemical Dynamics Research Laboratory. We will outline the choice of parameters and design philosophy, which are strongly driven by the demand of reliable and spectrally stable operation of the FEL for very special scientific experiments. The design is based on a 500 MHz recirculating superconducting electron linac with highest energy reach of about 60 MeV. The accelerator is injected with beams prepared by a specially designed gun-buncher system and incorporates a near-isochronous and achromatic recirculation line tunable over a wide range of beam energies. The stability issues considered to arrive at the specific design will be outlined.

6287 (LBL–32220) **The multi-cavity free-electron laser.** Krishnagopal, S.; Rangarajan, G.; Sessler, A. Lawrence Berkeley Lab., CA (United States). Jul 1992. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-9208142–10: 14. international free electron laser conference, Kobe (Japan), 23-28 Aug 1992; ESG–180). Order Number DE93002569. Source: OSTI; NTIS; INIS; GPO Dep.

Consideration is made of a free-electron laser with many optical cavities where the cavities communicate with each other, not optically, but through the electron beam. Analysis is made in Ole one-dimensional approximation. A general expression is given for the growth rate in the exponential (high current) regime. In the regime where lethargy is important expressions are given in the two opposite limits of small and large numbers of cavities and bunches. Numerical simulation results, still in the one-dimensional approximation, but including non-linearities, are presented. The multi-cavity free-electron laser (MC/FEL) can be employed to avoid the slippage phenomena, and thus to make picosecond pulses of infra-red radiation. Three examples of this application are presented.

6288 (LBL–32223) **Suppression of mode-beating in a saturated hole-coupled FEL oscillator.** Krishnagopal, S.; Xie, M.; Kim, K.J. Lawrence Berkeley Lab., CA (United States). Aug 1992. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-9208142–12: 14. international free electron laser conference, Kobe (Japan), 23-28 Aug 1992; ESG–183). Order Number DE93002554. Source: OSTI; NTIS; INIS; GPO Dep.

In a hole-coupled resonator, either empty or loaded with a linear FEL gain medium, the phenomenon of mode-degeneracy and mode-beating have been studied. When the magnitudes of the eigenvalues, derived from a linear analysis, are equal for two or more dominant eigenmodes, the system cannot achieve a stable beam-profile. We investigate this phenomenon when a saturated FEL is present within the cavity, thus introducing non-linearity. We use a three-dimensional FEL oscillator code, based on the amplifier code TDA, and show that mode-beating is completely suppressed in the nonlinear saturated regime. We suggest a simple, qualitative model for the mechanism responsible for this suppression.

6289 (LBL–32963) **A conceptual design for a primary cyclotron for the ISL radioactive beam project.** Clark, D.J. Lawrence Berkeley Lab., CA (United States). Jul 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-920741–6: 13 international conference on cyclotrons and their applications, Vancouver (Canada), 6-16 Jul 1992). Order Number DE93004777. Source: OSTI; NTIS; INIS; GPO Dep.

A design for a 600 MeV proton cyclotron is described. Features include a single stage with external ion source, a normal conducting magnet coil with 2 T peak field in the hills, and dees in valleys. The design can be extended to 800 and 1000 MeV.

6290 (SSCL-Preprint–158) **The SSC: Programme and searches for new particles.** Grinstein, B. Superconducting Super

Collider Lab., Dallas, TX (United States). Oct 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-9205274–1: Trieste workshop on the search for new elementary particles: particles, status and prospects, Trieste (Italy), 20-22 May 1992). Order Number DE93003262. Source: OSTI; NTIS; INIS; GPO Dep.

The Superconducting Super Collider (SSC) Laboratory is under construction. Many critical components have been designed, small and full scale prototypes built and successfully tested, and in some cases samples have been produced by industry. The 'Project', as we call the task of building the SSC Lab, is well under way. In this talk I will describe the Project and give an idea of what its status is to date. The physical potential of the SSC is extraordinary. Whatever is responsible for the spontaneous breaking of the electroweak symmetry, it must loom at the energies accessible at the SSC. It will produce top quarks copiously. And, most significantly, it will probe the shortest distance scales ever, opening up a new frontier in High Energy Physics. Also in this talk, I will touch on some of the physics of the SSC. I end the introduction with a disclaimer. This talk is about subjects outside my field of expertise. Describing the Project would be better left to an administrator or manager, while a discussion of what could be found and how, could 'certainly be done more properly by one of the many brilliant experimenters involved in the design of the major detectors for the SSC. Not all is lost, though. You will get what I hope is an interesting and peculiar, if not illuminating, insider/outsider's view. Insider's because I am employed by the SSC, and so I am embedded in the day to day discussions about the Project. Outsider's because I am neither a manager nor an experimentalist. Most of the material covered in this talk comes from conversations with my SSC colleagues and from their transparencies. I have also used some technical documents.

6291 (SSCL-SR–1216) **SSC Laboratory Operations Program Plan, FY 2000 to FY 2005.** Elioff, T. Superconducting Super Collider Lab., Dallas, TX (United States). Nov 1992. 89p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. Order Number DE93004394. Source: OSTI; NTIS; INIS; GPO Dep.

The Superconducting Super Collider Laboratory (SSCL) will be the world's premier high energy physics laboratory when its physics program begins at the turn of the century. If we are to optimize SSC's potential for physics discovery, ongoing research must continue to shape the details of the initial physics program plan. Nonetheless, it is important now to have a strategic plan for the SSC Laboratory's initial operating period. Such a plan is needed to guide the buildup of staff and the master plan for facilities at the Laboratory throughout the construction period. It is also an essential input into the long range-plan for the DOE's High Energy Physics Program. This report complements two other recent reports that deal with the near-term physics program and Laboratory operations by providing an endpoint to the scientific and technical staff buildup during the construction period.

4302 Beam Dynamics, Field Calculations, and Ion Optics

Refer also to citation(s) 6266, 6312, 6323, 6345

6292 (BNL–52348) **Radiation from moving charged particles with spin.** Luccio, A. Brookhaven National Lab., Upton, NY (United States). Alternating Gradient Synchrotron Dept. 5 Oct 1992. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (AGS/AD–93-1). Order Number DE93004633. Source: OSTI; NTIS; INIS; GPO Dep.

The theory of radiation emitted by a charged particle with spin in relativistic motion in an external magnetic field is reviewed. Approximate expressions suitable numerical computation, in far and near field, are derived. In particular, the case of the passage of a particle accelerator beam through an undulator is considered. It is shown that observation of the spectrum of the emitted radiation, in its two states of polarization, can be used not only for beam diagnostics, but also to measure the spin state of the accelerated particles. Undulator radiation is compared with Compton scattering of laser light by the particle beam. Examples for high energy electron and proton colliders are presented.

6293 (DOE/ER/40302–7) **Chaotic dynamics in accelerator physics: Progress report.** Cary, J.R. Colorado Univ., Boulder, CO (United States). Dept. of Astrophysical, Planetary, and Atmospheric Sciences. 30 Nov 1992. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-86ER40302. Order Number DE93004600. Source: OSTI; NTIS; INIS; GPO Dep.

Substantial progress was in several areas of accelerator dynamics. For developing understanding of longitudinal adiabatic dynamics, and for creating efficiency enhancements of recirculating free-electron lasers, was substantially completed. A computer code for analyzing the critical KAM tori that bound the dynamic aperture in circular machines was developed. Studies of modes that arise due to the interaction of coating beams with a narrow-spectrum impedance have begun. During this research educational and research ties with the accelerator community at large have been strengthened.

6294 (FNAL/C–92/187) **Reducing bunch disruption in transition crossing by modification of the rf waveform.** MacLachlan, J.; Griffin, J.; Crawford, C.; Wildman, D.; Bhat, C.; Martens, M. Fermi National Accelerator Lab., Batavia, IL (United States). Jul 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-920706–45: International conference on high energy accelerators, Hamburg (Germany), 20-24 Jul 1992). Order Number DE93002509. Source: OSTI; NTIS; INIS; GPO Dep.

We investigate the utility of accelerating during the nonadiabatic period surrounding the time of transition with an rf waveform modified by a second or third harmonic component to eliminate rf focusing. Simulation study shows this scheme not only to control momentum spread but also to have apparent advantage with respect to microwave instability. An experimental test has been initiated in the Fermilab Main Ring using a cavity at the third harmonic of the rf.

6295 (IYaF–90-127) **Calculation of electron spin motion in a nonlinear magnetic system of a storage ring using Lie method.** Ehjdel'man, Yu.I.; Yakimenko, V.E. AN SSSR, Novosibirsk (Russian Federation). Inst. Yadernoj Fiziki. 1990. [28] (In Russian). Order Number DE93609382. Source: OSTI; NTIS (US Sales Only); INIS.

Thr spin motion calculation using Lie method in collider nonlinear magnetic field Lie operator method of solving the spin equation in collider nonlinear fields is used. The matrix presentation of spin Lie transformation for particle passing through collider elements is obtained. The computer codes algorithms for nonlinear spin motion calculation are discussed. 6 refs.

6296 (KFTI–90-4) **Charged particle acceleration by high-current electron beam in plasma waveguide.** Balakirev, V.A.; Ostrovskij, A.O.; Tkach, Yu.V. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. [14] (In Russian). Order Number DE93609386. Source: OSTI; NTIS (US Sales Only); INIS.

Results of theoretical study of two-beam schematic representation of charged particle acceleration in plasma waveguide are given. It is stated that current of accelerated electrons with maximum energy constitutes 5-10% of guided beam total current. 12 refs.; 8 figs.

6297 (KFTI–90-11) **Nonlinear theory of charged particle bunch motion in high-frequency accelerating and focusing fields.** Korostelev, A.N.; Repalov, N.S.; Trofimenko, V.I.; Khizhnyak, N.A. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. [13] (In Russian). Order Number DE93609383. Source: OSTI; NTIS (US Sales Only); INIS.

Simulation method for accelerator with alternating-phase focusing (APF) based on high-current beam equilibrium diagram application and sequential matching of periods with various focusing properties. The program block-diagram for accelerator simulation according the given technique and longitudinal and transverse asscceptances of accelerating-focusing channel calculated using this program are presented. 11 refs.; 5 figs.; 2 tabs.

6298 (KFTI–90-13) **On the calculation of loaded cylindrical waveguides by the method of boundary integral equations.** Ostroushko, V.N. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. [7] (In Russian). Order Number DE93609384. Source: OSTI; NTIS (US Sales Only); INIS.

Method of calculation of loaded waveguides and cavity resonators based on integral equations with the use of tensor Green's function of Helmholtz's equation is developed. Application of the given method of loaded structures calculation is considered on the example of ball-loaded waveguide. 11 refs.

6299 (KFTI–90-17) **Study on the electrodynamical characteristics of an optimized shape accelerating resonator model.** Koba, I.I.; Popkov, Yu.P.; Telegin, Yu.N.; Trushkin, N.A.; Tsepilov, G.V. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. [13] (In Russian). Order Number DE93609385. Source: OSTI; NTIS (US Sales Only); INIS.

Experimental equipment and measuring techniques for RF-structure studies are described. The experimental data are in good agreement with computer simulation and analytical calculations. 7 refs.; 6 figs.; 3 tabs.

6300 (LA-UR–92-3582) **Considerations of the low-velocity stage of a radioactive beams accelerator.** Talbert, W.L. Los Alamos National Lab., NM (United States). [1992]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9210121–3: Workshop on the production and use of intense radioactive ion beams for the IsoSpin Laboratory, Oak Ridge, TN (United States), 7-10 Oct 1992). Order Number DE93003808. Source: OSTI; NTIS; INIS; GPO Dep.

Studies of the low-velocity stages of a radioactive beams accelerator are summarized, highlighting the limitations of existing RFQ technology when applied to the specifications of the IsoSpin Laboratory.

6301 (LBL–32221) **Physically transparent formulation of a free-electron laser in the linear gain regime.** Barletta, W.A. (Lawrence Livermore National Lab., CA (United States)); Sessler, A.M.; Yu, L.H. Lawrence Berkeley Lab., CA (United States). Aug 1992. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-9208142–8: 14. international free electron laser conference, Kobe (Japan), 23-28 Aug 1992; UCRL-JC–110770; ESG–181). Order Number DE93002577. Source: OSTI; NTIS; INIS; GPO Dep.

The recent 2-dimensional analytic theories of a free-electron laser (FEL) in the linear regime are reformulated in terms of three dimensionless ratios that describe the degree to which the characteristics of the electron beam deviate from the cold beam limit of a beam with no emittance or energy spread. In terms of these ratios, algebraic model equations of a fit that combines features of both of the 2-dimensional analyses are given as a convenient computational tool. Graphs of the FEL gain eigenvalue computed with the combined 2-D formulation illustrate that the gain and the output power at saturation are reduced from the 1-D value, when any of the ratios is larger than unity.

6302 (LBL–32286) **Calculation of 3-D free electron laser gain: Comparison with simulation and generalization to elliptical cross section.** Chin, Yong Ho; Kim, Kwang-Je; Xie, Ming. Lawrence Berkeley Lab., CA (United States). Aug 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (ESG–186;CONF-9208142–16: 14. international free electron laser conference, Kobe (Japan), 23-28 Aug 1992). Order Number DE93004768. Source: OSTI; NTIS; INIS; GPO Dep.

In the previous paper, we have derived a dispersion relation for the free electron laser (FEL) gain in the exponential regime taking account the diffraction and electron's betatron oscillation. Here, we compare the growth rates obtained by solving the dispersion relation with those obtained by simulation calculation for the waterbag and the Gaussian models for the electron's transverse phase space distribution. The agreement is found to be good except for the limiting case where the Rayleigh length is much longer than the gain length (1-D limit). We also generalize the analysis to the case where the electron beam cross section is elliptical as is usually the case in storage rings, and derive the first-order dispersion relation.

6303 (SSCL-Preprint–161) **Long-term stability in proton storage rings.** Talman, R. Superconducting Super Collider Lab., Dallas, TX (United States). Aug 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-920837–18: ICHEP-26: 26th International Union of Pure and Applied Physics (IUPAP) conference on high energy physics, Dallas, TX (United States), 6-12 Aug 1992). Order Number DE93003367. Source: OSTI; NTIS; INIS; GPO Dep.

The stability of Hamiltonian systems has been one of the fascinating concerns of physics over the centuries. Since protons circulating in high energy storage rings probably satisfy Hamiltonian requirements better than any other system that can be subjected to experimentation (the quality factor Q of their betatron oscillations is of order 10^9), the study of their stability is of natural interest. Of course, motivation is also provided by the desire to assure the long-term stability of protons in accelerators such as the SSC and the LHC. That is the subject of this report.

6304 (UM-P–91/91) **Electromagnetic deflection of spinning particles.** Costella, J.P.; McKellar, B.H.J. Melbourne Univ., Parkville, VIC (Australia). School of Physics. Sep 1991. [4] Order Number DE93609387. Source: OSTI; NTIS (US Sales Only); INIS.

Many applications use uniform magnetic fields to deflect charged particles into accurately known orbits. It is shown that particles with a magnetic dipole moment will also suffer an anomalous deflection in such fields if their energy is higher than a certain threshold. The closeness of the electron's g-factor to 2 leads to a sizeable decrease in its threshold energy, to such an extent that the effect could play a significant role in current high-energy accelerators. 18 refs.

6305 (WIS-PH–92-39) **Quantum adiabatic expansion for dynamics in strong magnetic fields.** Entelis, Anatoli; Levit Shimon. Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Physics. May 1992. [8] Order Number DE93609388. Source: OSTI; NTIS (US Sales Only); INIS.

In description of motion in a uniform strong magnetic field in the presence of external potentials the velocities of the cyclotron rotation and the guiding center coordinates are respectively fast and slow variables. We developed a quantum adiabatic expansion for this situation. In the adiabatic limit we find the effective action of the slow variables in which the energy 'surfaces' are local Landau levels depending on the coordinates of the guiding centers. The levels are not equidistant and may exhibit avoided crossings at which the transitions between the levels are concentrated. The action includes additional terms arising from Berry phase. These terms modify the simplectic form of the dynamics of the guiding centers and effect the WKB quantization. As a result it has a form of flux quantization through closed classical orbit of an effective magnetic field which in addition to the original field includes inhomogenous terms arising from the Berry phase and depending on the external potential. We present explicit calculations for the potentials which are weakly inhomogenous on the scale of the magnetic length. The standard strong field projection on a single Landau level is the first term of our expansion. (author).

4303 Auxiliaries and Components

Refer also to citation(s) 6090, 6213, 6375, 6387, 6389, 6390, 6393, 6394, 6395, 6396, 6397, 6398, 6399, 6401, 6435, 6436, 6818, 6964

6306 (ANL/ASD/CP–76106) **Comments on advanced, time-resolved imaging techniques for free-electron laser (FEL) experiments.** Lumpkin, A.H. Argonne National Lab., IL (United States). Advanced Photon Source Accelerator Systems Div. [1992]. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9208142–11: 14. international free electron laser conference, Kobe (Japan), 23-28 Aug 1992). Order Number DE93002897. Source: OSTI; NTIS; INIS; GPO Dep.

An extensive set of time-resolved imaging experiments has been performed on rf-linac driven free-electron lasers (FELs) over the past few years. These experiments have addressed both micropulse and macropulse timescales on both the charged-particle beam and the wiggler/undulator outputs (spontaneous emission

and lasing). A brief review of first measurements on photoinjecter micropulse elongation, submacropulse phase slew in drive lasers, submacropulse wavelength shifts in lasers, etc. is presented. This is followed by discussions of new measurements of 35-MeV electron beam micropulse bunch length (<10 ps) using optical transition radiation, some of the first single bend synchrotron radiation beam profile measurements at gamma <80, and comments on the low-jitter synchroscan streak camera tuner. These techniques will be further developed on the 200-650 MeV linac test stand at the Advanced Photon Source (APS) in the next few years. Such techniques should be adaptable to many of the present FEL designs and to some aspects of the next generation of light sources.

6307 (ANL/ASD/CP–77206) **The APS linac beam position monitors and electronics.** Fuja, R.; Chung, Youngjoo. Argonne National Lab., IL (United States). [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9210246–2: 1992 accelerator instrumentation workshop, Berkeley, CA (United States), 27-30 Oct 1992). Order Number DE93004184. Source: OSTI; NTIS; INIS; GPO Dep.

Beam position monitors using stripline pickups for 30 ns long electron and positron beam bunches have been built and responses were measured in the vertical and horizontal directions. Log amplifiers used for signal processing have a dynamic range of 40 dB and are scaled for 50 mV/dB sensitivity. In this paper we describe the design of the detectors, the signal processing electronics, and the results of the position-to-signal mapping using a wire. Beam position measurements using a prototype detector and electronics on the APS linac test stand are discussed.

6308 (ANL/ASD/CP–77462) **Preliminary design of the beam loss monitor system for the Advanced Photon Source.** Patterson, D.R. Argonne National Lab., IL (United States). Advanced Photon Source Accelerator Systems Div. [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9210246–3: 1992 accelerator instrumentation workshop, Berkeley, CA (United States), 27-30 Oct 1992). Order Number DE93004183. Source: OSTI; NTIS; INIS; GPO Dep.

The preliminary design of the beam loss monitor for the ANL Advanced Photon Source is based on the use of an air dielectric coaxial cable as a long ionization chamber. Each coaxial cable section uses a high sensitivity DC current-to-voltage converter with both linear and integrating ranges. Pulse timing circuits determine the positions of individual losses by measuring the time at which the resulting voltage pulses arrive at the beginning of the coaxial ionization chamber. A possible timing ambiguity can be removed by correlating the particle bunch timing with the resulting voltage pulse timing. Measurements have shown that pulse rise times less than 15 nanoseconds can be obtained, so that determining loss locations to better than 7 feet may be possible. Best performance may be obtained when 500 VDC is applied to a 50-ohm, 7/8-inch air dielectric coaxial cable filled with approximately 8 psig of a 95% argon, 5% carbon dioxide gas mixture. Cable lengths will be between 100 and 300 feet long, depending on the part of the accelerator being monitored.

6309 (ANL/ASD/CP–77464) **Design and initial tests of beam current monitoring systems for the APS transport lines.** Wang, Xucheng. Argonne National Lab., IL (United States). [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9210246–1: 1992 accelerator instrumentation workshop, Berkeley, CA (United States), 27-30 Oct 1992). Order Number DE93004185. Source: OSTI; NTIS; INIS; GPO Dep.

The non-intercepting beam current monitoring systems suitable for a wide, range of beam parameters have been developed for the Advanced Photon Source (APS) low energy transport lines and high energy transport line. The positron or electron beam pulse in the transport lines wig have peak beam currents ranging from 8 mA to 29 A with pulse widths varying from 120 ps to 30 ns and pulse repetition rates from 2 Hz to 60 Hz. The peak beam current or total beam charge is measured with the fast or integrating current transformer, respectively, manufactured by Bergoz. In-house high speed beam signal processing electronics provide a DC level output proportional to the peak current or total charge for the digitizer input. The prototype systems were tested on the linacs which have beam pulse structures similar to that of the APS transport lines. This paper describes the design of beam signal processing electronics and grounding and shielding methods for current transformers. The results of the initial operations are presented. A short introduction on the preliminary design of current monitoring systems for the APS rings is also included.

6310 (ANL/ASD/CP–77465) **Test results of a monopulse beam position monitor for the Advanced Photon Source.** Kahana, E.; Chung, Youngjoo. Argonne National Lab., IL (United States). Advanced Photon Source Accelerator Systems Div. [1992]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9210246–5: 1992 accelerator instrumentation workshop, Berkeley, CA (United States), 27-30 Oct 1992). Order Number DE93004180. Source: OSTI; NTIS; INIS; GPO Dep.

A prototype of the Monopulse Beam Position Monitor (BPM) was tested to determine the resolution capability for various signal levels and beam configurations. The BPM was tested in two environments: using a wire simulation of the beam in the laboratory and using real beam at various positions and levels at Stanford Synchrotron Radiation Laboratory. Both tests showed a resolution capability of better than 25 microns. This paper presents the procedures and measurements' results.

6311 (ANL/ASD/CP–77498) **Fluorescent screens and image processing for the APS linac test stand.** Berg, W.; Ko, K. Argonne National Lab., IL (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9210246–4: 1992 accelerator instrumentation workshop, Berkeley, CA (United States), 27-30 Oct 1992). Order Number DE93004182. Source: OSTI; NTIS; INIS; GPO Dep.

A fluorescent screen was used to monitor relative beam position and spot size of a 56-MeV electron beam in the linac test stand. A chromium doped alumina ceramic screen inserted into the beam was monitored by a video camera. The resulting image was captured using a frame grabber and stored into memory. Reconstruction and analysis of the stored image was performed using PV-WAVE. This paper will discuss the hardware and software implementation of the fluorescent screen and imaging system. Proposed improvements for the APS linac fluorescent screens and image processing will also be discussed.

6312 (ANL/CP–76440) **Simulation of U-5 prototype undulator effects on the beam dynamics.** Qian, Y.L.; Turner, L.R. Argonne National Lab., IL (United States). 6 Apr 1992. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-921116–19: 12. international conference on the application of accelerators in research and industry, Denton, TX (United States), 2-5 Nov 1992). Order Number DE93004251. Source: OSTI; NTIS; INIS; GPO Dep.

The APS prototype undulator U-5 has been installed at NSLS VUV ring. Its effects on the beam behaviour have been simulated with tracking codes TEAPOT and RACETRACK. The tune shift, the distortion of betatron function, the chromaticity, the transverse coupling, and some of the amplitude-dependent effects on the VUV ring have been compared and are presented in this paper.

6313 (ANL/CP–77509) **Liquid metal cooling of synchrotron optics.** Smither, R.K. Argonne National Lab., IL (United States). Sep 1992. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-920792–40: Society of Photo-Optical Instrumentation Engineers (SPIE) international symposium on optical applied science and engineering, San Diego, CA (United States), 19-24 Jul 1992). Order Number DE93002989. Source: OSTI; NTIS; INIS; GPO Dep.

The installation of insertion devices at existing synchrotron facilities around the world has stimulated the development of new ways to cool the optical elements in the associated x-ray beamlines. Argonne has been a leader in the development of liquid metal cooling for high heat load x-ray optics for the next generation of synchrotron facilities. The high thermal conductivity, high volume specific heat, low kinematic viscosity, and large working temperature range make liquid metals a very efficient heat transfer fluid. A

wide range of liquid metals were considered in the initial phase of this work. The most promising liquid metal cooling fluid identified to date is liquid gallium, which appears to have all the desired properties and the fewest number of undesired features of the liquid metals examined. Besides the special features of liquid metals that make them good heat transfer fluids, the very low vapor pressure over a large working temperature range make liquid gallium an ideal cooling fluid for use in a high vacuum environment. A leak of the liquid gallium into the high vacuum and even into very high vacuum areas will not result in any detectable vapor pressure and may even improve the vacuum environment as the liquid gallium combines with any water vapor or oxygen present in the system. The practical use of a liquid metal for cooling silicon crystals and other high heat load applications depends on having a convenient and efficient delivery system. The requirements for a typical cooling system for a silicon crystal used in a monochromator are pumping speeds of 2 to 5 gpm (120 cc per sec to 600 cc per sec) at pressures up to 100 psi.

6314 (ANL/EP/CP–77608) **Application of radiofrequency superconductivity to accelerators for high-current ion beams.** Delayen, J.R.; Bohn, C.L.; Kennedy, W.L.; Roche, C.T.; Sagalovsky, L. Argonne National Lab., IL (United States). [1992]. 17p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9210224–1: 13. National Particle Accelerator conference, Dubna (Russian Federation), 13-15 Oct 1992). Order Number DE93002925. Source: OSTI; NTIS; INIS; GPO Dep.

A development program is underway to apply rf superconductivity to the design of continuous-wave (cw) linear accelerators for high-current, high-brightness ion beam. During the last few years, considerable progress has been made both experimentally and theoretically toward this application. Recent tests of niobium resonators for ion acceleration have yielded average accelerating gradients as high as 18 MV/m. In an experiment with a radio-frequency quadrupole geometry, niobium was found to sustain cw peak surface electric fields as high as 128 MV/m over large (10 cm) surface areas. Theoretical studies of beam halo, cumulative beam breakup and alternating-phase focusing have also yielded important results. This paper su-summarizes the recent progress and identifies current and future work in the areas of superconducting accelerator technology for high-current ion beams.

6315 (ANL/PHY/CP–76643) **The positive-Ion injector of ATLAS: Design and operating experience.** Bollinger, L.M.; Pardo, R.C.; Shepard, K.W.; Billquist, P.J.; Bogaty, J.M.; Clifft, B.E.; Harkewicz, R.; Munson, F.H.; Nolen, J.A.; Zinkann, G.P. Argonne National Lab., IL (United States). Physics Div. [1992]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-921116–18: 12. international conference on the application of accelerators in research and industry, Denton, TX (United States), 2-5 Nov 1992). Order Number DE93004199. Source: OSTI; NTIS; INIS; GPO Dep.

The recently completed Positive-Ion Injector for the heavy-ion accelerator ATLAS is a replacement for the tandem injector of the present tandem-linac system. Unlike the tandem, the new injector provides ions from the full range of the periodic table. The concept for the new injector, which consists of an ECR ion source on a voltage platform coupled to a very-low-velocity superconducting linac, introduces technical problems and uncertainties that are well beyond those encountered previously for superconducting linacs. The solution to these problems and their relationship to performance are outlined, and experience in the operation of ATLAS with its new injector is discussed.

6316 (ANL/PHY/CP–77681) **Status of the ATLAS control system upgrade.** Munson, F.H.; Ferraretto, M.; Rutherford, B. Argonne National Lab., IL (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9209206–3: Symposium of northeastern accelerator personnel (SNEAP), Quebec (Canada), 23-25 Sep 1992). Order Number DE93002915. Source: OSTI; NTIS; INIS; GPO Dep.

Certain components of the ATLAS control system are two generations behind today's technology. It has been decided to upgrade the control system. in part, by replacing Digital Equipment Corporation (DEC) PDP-11 computers with present-day VAX technology. Two primary goals have been defined for the upgraded control system. The first of these goals is to keep additional "in-house" written software to a minimum, while providing the portability necessary to ensure the continued use of existing software. In an attempt to achieve this goal, commercially-available software has been utilized to provide a foundation for the final control-system configuration. The second goal is to develop the new control system, while not interfering with accelerator operations. This paper describes some of the motivation for upgrading the ATLAS control system, the basic features of the new control system, and the present status of the system's development.

6317 (ANL/TM–459-Rev.4) **Survey of ANL organization plans for word processors, personal computers, workstations, and associated software: Revision 4.** Fenske, K.R.; Rockwell, V.S. Argonne National Lab., IL (United States). Aug 1992. 174p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93004821. Source: OSTI; NTIS; GPO Dep.

The Computing and Telecommunications Division (CTD) has compiled this Survey of ANL Organization plans for Word Processors, Personal Computers, Workstations, and Associated Software (ANL/TM, Revision 4) to provide DOE and Argonne with a record of recent growth in the acquisition and use of personal computers, microcomputers, and word processors at ANL. Laboratory planners, service providers, and people involved in office automation may find the Survey useful. It is for internal use only, and any unauthorized use is prohibited. Readers of the Survey should use it as a reference document that (1) documents the plans of each organization for office automation, (2) identifies appropriate planners and other contact people in those organizations and (3) encourages the sharing of this information among those people making plans for organizations and decisions about office automation. The Survey supplements information in both the ANL Statement of Site Strategy for Computing Workstations (ANL/TM 458) and the ANL Site Response for the DOE Information Technology Resources Long-Range Plan (ANL/TM 466).

6318 (ANL/XFD/CP–76595) **High-energy resolution, high-angular acceptance crystal monochromator.** Toellner, T.S. (Argonne National Lab., IL (United States)); Mooney, T.; Alp, E.E.; Shastri, S. Argonne National Lab., IL (United States). Jun 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-920768–7: Conference on physics and engineering of advanced detectors and collection/focusing systems, San Diego, CA (United States), 19-24 Jul 1992). Order Number DE93004195. Source: OSTI; NTIS; GPO Dep.

The design principles, construction and characterization of a 4-bounce dispersive crystal monochromator is discussed. This monochromator is designed to reduce the bandpass of synchrotron radiation to 10–50 meV level, without sacrificing angular acceptance. This is achieved by combining an asymmetrically-cut, low order reflection with a symmetrically-cut, high order reflection in a nested configuration. This monochromator is being used as a beam conditioner for nuclear resonant scattering of synchrotron radiation to produce x-rays with μeV–neV resolution in the hard x-ray regime.

6319 (ANL/XFD/CP–77745) **Absorption of undulator radiation in media.** Dejus, R.J.; Lai, B.; Khounsary, A.M. Argonne National Lab., IL (United States). [1992]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-920792–41: Society of Photo-Optical Instrumentation Engineers (SPIE) international symposium on optical applied science and engineering, San Diego, CA (United States), 19-24 Jul 1992). Order Number DE93002921. Source: OSTI; NTIS; INIS; GPO Dep.

Detailed thermal stress analyses of beamline and optical components subject to high heat loads require an Accurate determination of the absorbed power profile for accurate prediction of the temperature profile and structural parameters. This is particularly important for high power beams from wigglers and undulators at the third generation synchrotron sources because components

must, in general, be designed and maintained with strict mechanical tolerances. The spatial distribution of the power density of an undulator is a rapidly varying function of the energy of the photons suggesting that approximative methods based on a smooth spectral variation may not be valid. In this paper, a fast code for calculating undulator spectra is developed and compared with a wiggler code for approximation of the same spectra. Results from numerical simulations, including the emittance of the stored particle beam, are presented for the absorbed power density in a beryllium window. We find markedly different results for the two models for far off-axis radiation indicating the inadequacy of the wiggler model applied to an undulator spectrum in this case. The wiggler model overestimates the total absorbed power by as much as 82% for the beryllium window.

6320 (ANL/XFD/CP–77991) **Thermal, structural, and fabrication aspects of diamond windows for high power synchrotron x-ray beamlines.** Khounsary, A.M. (Argonne National Lab., IL (United States)); Phillips, W. Argonne National Lab., IL (United States). [1992]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-920792–44: Society of Photo-Optical Instrumentation Engineers (SPIE) international symposium on optical applied science and engineering, San Diego, CA (United States), 19-24 Jul 1992). Order Number DE93004194. Source: OSTI; NTIS; INIS; GPO Dep.

Recent advances in chemical vapor deposition (CVD) technology have made it possible to produce thin free-standing diamond foils that can be used as the window material in high heat load, synchrotron beamlines. Numerical simulations suggest that these windows can offer an attractive and at times the only alternative to beryllium windows for use in third generation x-ray synchrotron radiation beamlines. Utilization, design, and fabrication aspects of diamond windows for high heat load x-ray beamlines are discussed, as are the microstructure characteristics bearing on diamond's performance in this role. Analytic and numerical results are also presented to provide a basis for the design and testing of such windows.

6321 (BNL–47851) **Measurements of magnetic permeability and H_c of magnet steels using digital techniques.** Thomas, R.; Morgan, G. Brookhaven National Lab., Upton, NY (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9205272–1: 11. annual conference on properties and applications of magnetic materials, Chicago, IL (United States), 12-14 May 1992). Order Number DE93002328. Source: OSTI; NTIS; INIS; GPO Dep.

The magnet-to-magnet variations in the dipole field of superconducting accelerator magnets must fall within specified tolerances to avoid excessive beam losses during injection. At injection field levels (~ 0.4 T for RHIC), the variations in the field attributable to the iron arise from variations in the chemical impurities, cold working and heat treatment. These structure-sensitive effects can be characterized by measuring the permeability and coercive force, H_c, of iron samples. A digital permeameter was developed to perform precise measurements of the magnetic properties of ring samples. An arbitrary function generator and two high-precision digital multimeters were connected to a desktop computer using the IEEE-488 bus, and software was written to automatically acquire and analyze the data. Through the use of the arbitrary waveform generator, the effect of varying the period of the B-H loop and the effect of varying the shape of the H waveform were explored. The effects of annealing, bending and flattening, and temperature on H_c and the relative permeability have been investigated for samples of magnet steel from several manufacturers.

6322 (BNL–47861) **A precise technique for manufacturing correction coil.** Schieber, L. Brookhaven National Lab., Upton, NY (United States). [1992]. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-920331–60: International industrial symposium on the super collider, New Orleans, LA (United States), 4-6 Mar 1992). Order Number DE93002329. Source: OSTI; NTIS; INIS; GPO Dep.

An automated method of manufacturing correction coils has been developed which provides a precise embodiment of the coil design. Numerically controlled machines have been developed to accurately position coil windings on the beam tube. Two types of machines have been built. One machine bonds the wire to a substrate which is wrapped around the beam tube after it is completed while the second machine bonds the wire directly to the beam tube. Both machines use the Multiwire® technique of bonding the wire to the substrate utilizing an ultrasonic stylus. These machines are being used to manufacture coils for both the SSC and RHIC.

6323 (CONF-9206193–18) **An inverse free electron laser accelerator experiment.** Wernick, I.; Marshall, T.C. Columbia Univ., New York, NY (United States). Dept. of Applied Physics. [1992]. 7p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract FG02-91ER40669. Grant N00014-89-J-1652;Grant ECS-89-13066. From Advanced accelerator concepts workshop; Port Jefferson, NY (United States); 14-20 Jun 1992. Order Number DE93003495. Source: OSTI; NTIS; INIS; GPO Dep.

A free electron laser was configured as an autoaccelerator to test the principle of accelerating electrons by stimulated absorption of radiation (λ = 1.65mm) by an electron beam (750kV) traversing an undulator. Radiation is produced in the first section of a constant period undulator (1_{w1} = 1.43cm) and then absorbed (~ 40%) in a second undulator, having a tapered period (1_{w2} = 1.8 – 2.25cm), which results in the acceleration of a subgroup (~ 9%) of electrons to ~ 1MeV.

6324 (FNAL/C–92/227) **Third harmonic rf cavity for transition crossing in the Main Ring.** Bhat, C.M. Fermi National Accelerator Lab., Batavia, IL (United States). Aug 1992. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-9206310–1: Superconducting Super Collider Laborabory (SSCL) rf workshop, Argonne, IL (United States), 25-26 Jun 1992). Order Number DE93002818. Source: OSTI; NTIS; INIS; GPO Dep.

This paper reports the present status and future plans of the implementation of the transition crossing RF harmonic system at Fermilab. The test is being carried out in the Main Ring (MR) which is used as a 150 GeV injector to the Tevatron.

6325 (FNAL/C–92/257) **AC loss measurements of model and full size 50mm SSC collider dipole magnets at Fermilab.** Ozelis, J.P. (Fermi National Accelerator Lab., Batavia, IL (United States)); Delchamps, S.W.; Gourlay, S.; Jaffery, T.; Kinney, W.; Koska, W.; Kuchnir, M.; Lamm, M.J.; Mazur, P.O.; Orris, D.; Strait, J.; Wake, M.; Dimarco, J.; Kuzminski, J.; Zheng, H. Fermi National Accelerator Lab., Batavia, IL (United States). Sep 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-920802–38: Applied superconductivity conference, Chicago, IL (United States), 23-28 Aug 1992). Order Number DE93004408. Source: OSTI; NTIS; INIS; GPO Dep.

Tests have recently been performed at Fermilab in order to measure the energy losses due to eddy currents and iron and superconductor magnetization. These measurements were performed on six 1.5m long model magnets and eight 15m long full scale collider dipole magnets. AC losses were measured as a function of ramp rate using sawtooth ramps from 500, to 5000 Amps for both types of magnets, while bipolar studies were additionally performed on some of the short magnets. The measured magnet voltage and current for a complete cycle are digitally integrated to yield the energy loss per cycle. Measurement reproducibility is typically 5%, with good agreement between long magnet measurements and extrapolations from short magnet measurement results. Magnetization loss measurements among similar magnet types agree to within experimental error, while eddy current losses correlate strongly with the observed dependence of quench current on ramp rate.

6326 (FNAL/C–92/268) **murmur: A message generator and reporter for Unix, VMS and VxWorks.** Oleynik, G.; Appelton, L.; MacKinnon, B.; Moore, C.; Sergey, G.; Udumula, L. Fermi National Accelerator Lab., Batavia, IL (United States). Oct 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-920966–13: 10. conference on computing in high energy physics, Annecy (France), 21-25 Sep 1992). Order Number DE93004412. Source: OSTI; NTIS; INIS; GPO Dep.

This paper describes the software product, "murmur," a message generation, reporting, display and logging software system that we

have developed for use in data acquisition systems at Fermilab. "murmur" is a tool for the production and management of message reporting. Its usefulness ranges from software product development and maintenance to system level shakedown and diagnostics. "murmur" provides a VMS MESSAGE-like function code generation utility, a client routine package for sending these codes over the network to a central server, and a server which translates the codes into meaningful visual information, writes the information to a logfile and displays it on X windows. Information associated with message codes such as message text, message color, X display configuration and routing information, and other related information are kept in fast access keyed files and can be modified by a set of Motif based configuration editors. As a result, "murmur" provides advanced features such as popping up help when a displayed message is clicked on by the mouse and executing "action" shell scripts when selected messages are received by the server. The server and editors are written in C++ for extensibility and maintainability, and are currently available on Sun and SGI systems. The client library is written in C, and has a Fortran binding as well. Clients are supported on SGI IRIX, Sun SunOS, IBM AIX, DEC ULTRIX, VAX VMS, and under the VxWorks real-time kernel operating system.

6327 (FNAL/C–92/269-E) **Neural networks at the Tevatron.** Badgett, W. (Michigan Univ., Ann Arbor, MI (United States)); Burkett, K.; Campbell, M.K.; Wu, D.Y.; Bianchin, S.; DeNardi, M.; Pauletta, G.; Santi, L.; Caner, A.; Denby, B.; Haggerty, H.; Lindsey, C.S.; Wainer, N.; Dall'Agata, M.; Johns, K. Fermi National Accelerator Lab., Batavia, IL (United States). Oct 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-920966–14: 10. conference on computing in high energy physics, Annecy (France), 21-25 Sep 1992). Order Number DE93004413. Source: OSTI; NTIS; INIS; GPO Dep.

This paper summarizes neural network applications at the Fermilab Tevatron, including the first online hardware application in high energy physics (muon tracking): the CDF and DO neural network triggers; offline quark/gluon discrimination at CDF; ND a new tool for top to multijets recognition at CDF.

6328 (FNAL/C–92/277) **Experiences with the ACPMAPS 50 GFLOP system.** Fischler, M. Fermi National Accelerator Lab., Batavia, IL (United States). Oct 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-920966–15: 10. conference on computing in high energy physics, Annecy (France), 21-25 Sep 1992). Order Number DE93004418. Source: OSTI; NTIS; INIS; GPO Dep.

The Fermilab Computer R&D and Theory departments have for several years collaborated on a multi-GFLOP (recently upgraded to 50 GFLOP) system for lattice gauge calculations. The primary emphasis is on flexibility and ease of algorithm development. This system (ACPMAPS) has been in use for some time, allowing theorists to produce QCD results with relevance for the analysis of experimental data. We present general observations about benefits of such a scientist-oriented system, and summarize some of the advances recently made. We also discuss what was discovered about features needed in a useful algorithm exploration platform. These lessons can be applied to the design and evaluation of future massively parallel systems (commercial or otherwise).

6329 (FNAL/C–92/291) **Magnetic field angle changes during manufacture and testing of SSC collider dipoles.** Kuchnir, M. (Fermi National Accelerator Lab., Batavia, IL (United States)); Bleadon, M.; Delchamps, S.W.; Schmidt, E.; Bossert, R.; Carson, J.; Gourlay, S.; Hanft, R.; Koska, W.; Lamm, M.J.; Mazur, P.O.; Orris, D.; Ozelis, J.; Strait, J.; Wake, M.; Devred,Fermi National Accelerator Lab., Batavia, IL (United States). Oct 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-920802–40: Applied superconductivity conference, Chicago, IL (United States), 23-28 Aug 1992). Order Number DE93004422. Source: OSTI; NTIS; INIS; GPO Dep.

Measurements of the magnetic field angle along the length of collider dipole magnets are discussed. These superconducting magnets were built at Fermilab for the Superconducting Super Collider (SSC) by Fermilab and General Dynamics personnel. These measurements were made at four stages in the assembly and test sequence. The data show-that changes can occur both during installation in the cryostat and as a result of cold testing. Most of the changes during installation are correlated with the welding of the tie bar restraints. But the changes observed as a result of the cold testing can be attributed to changes in the magnetization of the iron laminations.

6330 (FNAL/C–92/296) **FASTBUS Standard Routines implementation for Fermilab embedded processor boards.** Pangburn, J. (Fermi National Accelerator Lab., Batavia, IL (United States)); Patrick, J.; Kent, S.; Oleynik, G.; Pordes, R.; Votava, M.; Heyes, G.; Watson, W.A. III. Fermi National Accelerator Lab., Batavia, IL (United States). Oct 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-921005–11: Nuclear science symposium, Orlando, FL (United States), 26-31 Oct 1992). Order Number DE93004423. Source: OSTI; NTIS; INIS; GPO Dep.

In collaboration with CEBAF, Fermilab's Online Support Department and the CDF experiment have produced a new implementation of the IEEE FASTBUS Standard Routines for two embedded processor FASTBUS boards: the Fermilab Smart Crate Controller (FSCC) and the FASTBUS Readout Controller (FRC). Features of this implementation include: portability (to other embedded processor boards), remote source-level debugging, high speed, optional generation of very high-speed code for readout applications, and built-in Sun RPC support for execution of FASTBUS transactions and lists over the network.

6331 (FNAL/C–92/300) **Integrated FASTBUS, VME and CAMAC diagnostic software at Fermilab.** Anderson, J.; Forster, R.; Franzen, J.; Wilcer, N. Fermi National Accelerator Lab., Batavia, IL (United States). Oct 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-9210232–4: Institute Electrical and Electronic Engineers (IEEE) meeting, Orlando, FL (United States), 26-30 Oct 1992). Order Number DE93004424. Source: OSTI; NTIS; INIS; GPO Dep.

A fully integrated system for the diagnosis and repair of data acquisition hardware in FASTBUS, VME and CAMAC is described. A short cost/benefit analysis of using a distributed network of personal computers for diagnosis is presented. The SPUDS (Single Platform Uniting Diagnostic Software) software package developed at Fermilab by the authors is introduced. Examples of how SPUDS is currently used in the Fermilab equipment repair facility, as an evaluation tool and for field diagnostics are given.

6332 (FNAL/C–92/304) **The D0 Upgrade Program and its physics potential.** Rijssenbeek, M. (State Univ. of New York, Stony Brook, NY (United States)). The D0 Collaboration. Fermi National Accelerator Lab., Batavia, IL (United States). Oct 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-920837–28: ICHEP-26: 26th International Union of Pure and Applied Physics (IUPAP) conference on high energy physics, Dallas, TX (United States), 6-12 Aug 1992). Order Number DE93004744. Source: OSTI; NTIS; INIS; GPO Dep.

The Fermilab Collider will be upgraded in a series of steps over the coming five years, with a 50-fold luminosity increase and shortening of the bunch crossing time from 3.5 μs to 400 ns. These changes in environment necessitate changes in several of the D0 detectors, their electronics and the triggers. In addition, we expect that with the large increase in accumulated luminosity and based upon the analysis of data from the first few runs, new physics opportunities shall be available. This evolution of the physics program in the era preceeding the SSC also affects the choices for the D0 upgrade. The upgraded detector which has been proposed and partially approved will be motivated and described.

6333 (FNAL/C–92/310) **Run control and resource management in the D0 run time system.** Gibbard, B. The D0 Collaboration. Fermi National Accelerator Lab., Batavia, IL (United States). Oct 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000 ;AC02-76CH00016. (CONF-920966–16: 10. conference on computing in high energy physics, Annecy (France), 21-25 Sep 1992; BNL–48149). Order Number DE93004749. Source: OSTI; NTIS; INIS; GPO Dep.

The D-Zero run time system consists of a number of distinct subsystems which perform the basic functions of triggering, digitizing, data gathering, and data recording. The allocation and high level coordination of the elements in this system are accomplished by a server task which maintains and consults a detailed model of the system. The strengths and weaknesses of this method of operation and the underlying data taking architecture are discussed.

6334 (FNAL-TM-1811) **PS1 satellite refrigerator heat exchanger: Failure of the LN2 heat exchanger to low pressure helium.** Squires, B. Fermi National Accelerator Lab., Batavia, IL (United States). Nov 1992. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. Order Number DE93005616. Source: OSTI; NTIS; INIS; GPO Dep.

The PS1 heat exchanger is one of three prototype heat exchangers built by Atomic Welders before Meyer was given the contract to build the Satellite Refrigerator Heat Exchanger components. This heat exchanger was first put into operation in July 1983. In November 1991, this heat exchanger experienced a failure in the shell of heat exchanger 1 causing nitrogen to contaminate the helium in the refrigerator. The resulting contamination plugged heat exchanger 3. The break occurred at a weld that connects a 0.25 inch thick ring to heat exchanger 1. The failure appears to be a fatigue of the shell due to temperature oscillations. The flow rate through the break was measured to be 1.0 scfm for a pressure drop over the crack of 50 psi. An ANSYS analysis of the failure area indicates that the stress would be 83,000 psi if the metal did not yield. This is based on cooling down the shell to 80K from 300K with the shell side helium on the outside of the shell at 300K. This is the largest change in temperature that occurs during operation. During normal operations, the temperature swings are not nearly this large, however temperatures down to 80K are not unusual (LN2 overflowing pot). The highest temperatures are typically 260K. The analysis makes no attempt to estimate the stress concentration factor at this weld but there is no doubt that it is greater than 1. No estimate as to the number of cycles to cause failure was calculated nor any estimate as to the actual number of cycles was made.

6335 (GSI-92-08) **The Z-pinch as plasma lens for the focusing of heavy ion beams.** Elfers, M. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany); Technische Hochschule Aachen (Germany). Fakultaet fuer Maschinenwesen. Apr 1992. 77p. (In German). Order Number DE93742919. Source: OSTI; NTIS (US Sales Only); INIS.

In the present thesis the influence of a Z-pinch plasma on the shape of heavy-ion beams and the for the understanding of this interaction most important plasma parameters were studied. For this the Z-pinch at the heavy-ion accelerator UNILAC was operated. The magnet field gradients of up to (25 $\pm$ 3) T/m occuring in the Z-pinch lead to the plasma-lens effect - the focusing of a charged-particle beam traversing axially the Z-pinch. In this thesis for the first time the focusing of a heavy-ion beam by the azimutal magnetic field of a Z-pinch is described. Different beams with an original diameter of 10 mm were focused. The smallest measured beam diameter amounts to 1 mm half-width. The beam energy amounts to 11.4 MeV/u, which leads at gold as projectile matter to a beam energy of 2.25 GeV. (orig./HSI).

6336 (INS-920) **Performance characteristics of the INS 25.5-MHz split coaxial RFQ.** Tokuda, N.; Arai, S.; Imanishi, A.; Morimoto, T.; Shibuya, S.; Tojyo, E. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Apr 1992. 4p. Order Number DE93753168. Source: OSTI; NTIS; INIS.

The performance of the INS 25.5-MHz split coaxial RFQ has been clarified through high-power and acceleration tests. The cavity operates stably at a duty factor of 20% and a peak power of 80 kW, generating an intervane voltage of 109.3 kV, the design value for ions with a charge-to-mass ratio of 1/30. Acceleration tests have been conducted to study the performance of the vanes machined by means of the two-dimensionally cutting technique. The results show that the A_{10} coefficient of the electric field will be close to the one calculated by Crandall, and that the field in the radial matching section might be different from the designed one. (author).

6337 (INS-922) **Slow beam extraction at TARNII.** Tomizawa, M. (and others); Yoshizawa, M.; Chida, K. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Apr 1992. 4p. Order Number DE93753100. Source: OSTI; NTIS; INIS.

Beam test of a slow extraction by utilizing the 3rd order resonance has been performed to investigate the characteristics of the extraction system at TARNII and to develop a new technique with the slow extraction. High extraction efficiency was obtained by the extraction without accelerating beam. Time dependence of the profile of the extracted beam and micro-structure of the beam spill were measured. Furthermore we succeeded to extract the beam by a new method utilizing the emittance growth of the circulating beam in the ring. (author).

6338 (IYaF-91-107) **Multichannel analyzer of energy spectra of a magnetized relativistic electron beam.** Astrelin, V.T.; Burdakov, A.V.; Nikiforov, A.A.; Chikunov, V.V. AN SSSR, Novosibirsk (Russian Federation). Inst. Yadernoj Fiziki. 1991. [15] (In Russian). Order Number DE93609403. Source: OSTI; NTIS (US Sales Only); INIS.

A description of a magnetic step-analyser of intense relativistic electron beam energy spectra is presented. The azimuthal magnetic field in the analyser is created by the current flowing through two coaxial cylinders. The particles move in the analyser along the trajectories, representing spirals with the pitch depending on the energy and rolled on the magnetic field spiral force lines. The magnetic analyser serviceability is demonstrated at the U-1 device with 1.1 MeV electron beam energy and 50 kA current. 6 refs.; 7 figs.; 2 tabs.

6339 (KEK-91-14) **Estimation of the longitudinal impedance of the ATF damping ring.** Takao, M.; Higo, T.; Bane, K.L.F. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Mar 1992. 20p. Order Number DE93753099. Source: OSTI; NTIS; INIS.

In order to estimate the possibility of bunch lengthening in the ATF damping ring, the longitudinal broad-band impedance of the ring was evaluated numerically. The impedance was found to be so small that the bunch the lengthening should not be observed in the design of the ATF damping ring. (author).

6340 (LA-UR-92-3494) **Testing intelligent power supplies for the Los Alamos National Laboratory Accelerator Complex.** Sturrock, J.C.; Cohen, S.; Weintraub, B.L.; Hayden, D.J.; Archuletta, S.F. Los Alamos National Lab., NM (United States). [1992]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-920843-2: 3. Institute of Electrical and Electronic Engineers (IEEE) workshop on computers in power electronics, Berkeley, CA (United States), 9-11 Aug 1992). Order Number DE93003749. Source: OSTI; NTIS; INIS; GPO Dep.

New high-current, high-precision microprocessor-controlled power supplies, built by Alpha Scientific Electronics of Hayward, CA, have been installed at the Los Alamos National Laboratory Accelerator Complex. Twenty-four power supplies have been ordered, the first of which is a 600-kilowatt supply installed in the Magnet Measurement Facility. Tests were conducted on this supply to verify adherence to specification and to ascertain ultimate long-term stability and performance. Specification of these supplies requires current regulation of 0.002% of maximum output and long-term stability of 0.001% of full current rating over a twelve-hour period. A large (twenty ton) dipole magnet was used as a load to fully exercise the supply up to its 3000-Ampere capability. Test design is described and results are presented in this paper.

6341 (LA-UR-92-3569) **Testing and interfacing intelligent power supplies for the Los Alamos National Laboratory Accelerator Complex.** Sturrock, J.C.; Cohen, S.; Weintraub, B.L.; Hayden, D.J.; Archuleta, S.F. Los Alamos National Lab., NM (United States). [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-921005-9: Nuclear science symposium, Orlando, FL (United States), 26-31 Oct 1992). Order Number DE93003786. Source: OSTI; NTIS; INIS; GPO Dep.

New high-current, high-precision microprocessor-controlled power supplies, built by Alpha Scientific Electronics of Hayward, CA, have been installed at the Los Alamos National Laboratory Accelerator

Complex. Each unit has sophisticated microprocessor control onboard and communicates via RS-422 (serial communications). The units use a high level ASCII-based control protocol. Performance tests were conducted to verify adherence to specification and to ascertain ultimate long-term stability. The "front-end" software used by the accelerator control system has been written to accommodate these new devices. The supplies are interfaced to the control system through a terminal server port connected to the site-wide ediernet backbone. Test design and results as well as details of the software implementation for the analog and digital control of the supplies through the accelerator control system are presented.

6342 (LA-UR–92-3664) **Penning surface-plasma source scaling laws: Theory and practice.** Smith, H.V. Jr.; Allison, P.; Sherman, J.D. Los Alamos National Lab., NM (United States). [1992]. 10p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-921145–1: Production and neutralization of negative ions and beams, Upton, NY (United States), 9-13 Nov 1992). Order Number DE93003814. Source: OSTI; NTIS; GPO Dep.

The small-angle source (SAS), 4X source, and 8X source are Penning surface-plasma sources (SPS) that produce high-current, high-brightness H^- ion beams for accelerator applications. It is desirable to achieve high duty-factor (df) operation, ultimately dc, with a Penning SPS. Two developments may make this goal possible. First, the H^- beam-emission scaling from the SAS (the 1X device) to the 4X source, and from the 4X source to the 8X source, is more favorable than the scaling laws predict Second, fringe-field separation of the e^- and H^- beams may make it possible to handle the power of the coextracted e^- beam, especially since a collar arrangement reduces the e^- loading. We compare our measured results with the predictions of the Penning SPS scaling laws. Particular attention is paid to the H^- current and temperature scaling as well as the power efficiency.

6343 (LBL–32071) **A 50 mm bore superconducting dipole with a unique iron yoke structure.** Dell'Orco, D.; Caspi, S.; O'Neill, J.; Lietzke, A.; Scanlan, R.; Taylor, C.E.; Wandesforde, A. Lawrence Berkeley Lab., CA (United States). Aug 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-920802–35: Applied superconductivity conference, Chicago, IL (United States), 23-28 Aug 1992). Order Number DE93002547. Source: OSTI; NTIS; INIS; GPO Dep.

A 50 mm bore superconducting dipole with a thin stainless steel collar and a close in elliptical iron yoke was designed in order to obtain a high transfer function SW low saturation effects on the multipoles, and a one meter model was built and tested. Training behavior of the first 1 m model, called D19, is presented at 4.3 K and 1.8 K. At 1.8 K it reached the record field of 10.06 T. The two layer cos θ winding uses 30 and 36 strand cables identical to the cables of the 50 mm bore SSC dipole and it has an operating field of 6.6 T at 4.35 K with a current of 5800 A. To evaluate behavior at high fields, the mechanical structure for the model was designed for 10 T. The thin collar itself provides only a minimum prestress of 10 MPa. and the full prestress of 70 MPa is given by the iron yoke. An aluminum spacer is used to control the gap size in the vertically split iron yoke. The tapered gap in the yoke is determined by the size of the Al spacer so that during cooldown there is no loss of coil prestress and the gap remains closed when the magnet is energized.

6344 (LBL–32072) **Design of the Nb_3Sn dipole D20.** Dell'Orco, D.; Scanlan, R.; Taylor, C.E. Lawrence Berkeley Lab., CA (United States). Aug 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-920802–26: Applied superconductivity conference, Chicago, IL (United States), 23-28 Aug 1992). Order Number DE93002578. Source: OSTI; NTIS; INIS; GPO Dep.

The design of a 50 mm bore superconducting Nb_3Sn dipole with a short sample field of 13 T at 4.3 K and a current of 5500 A/turn is presented. The magnet is composed by two double pancake layers. The inner cable has 37 strands with a strand diameter of 0.75 mm and a Cu/Sc ratio of 0.4; the outer cable has 47 strands with a diameter of 0.48 mm and a Cu/Sc ratio of 1.15. In order to obtain a high transfer function and low saturation effects on the multipoles, the stainless steel collar is elliptical and the iron yoke is "close-in." The thin collar itself provides only a minimum prestress and the full prestress of 100 MPa is given by a 25 mm welded stainless steel shell or by winding a wire around the yoke. Aluminum spacers are used as assembly tools and as a means to control the gap size in the vertically split iron yoke. This paper presents the magnetic design and the calculated stress and strain distribution in structure and coils. A 1 m model called D20 is to be built and tested at LBL.

6345 (LBL–32178) **Field profile and loading measurements on higher order modes in a two cell 500 MHz superconducting structure.** Barry, W. (Lawrence Berkeley Lab., CA (United States)); Edighoffer, J.; Chattopadhyay, S.; Fornaca, S. Lawrence Berkeley Lab., CA (United States). Aug 1992. 3p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract AC03-76SF00098. Contract N00014-91-4152. (ESG–176;CONF-9208109–70: 16. international LINAC conference, Ottawa (Canada), 23-28 Aug 1992). Order Number DE93004771. Source: OSTI; NTIS; INIS; GPO Dep.

The Infrared Free Electron Laser, being designed at LBL as part of the Chemical Dynamics Research Laboratory, is based on a 500 MHz superconducting linac driver that consists of five 4-cell structures of the CERN/DESY type. A 500 MHz, 2-cell version of this structure is being used in a joint Stanford/LBL/BNL program to study accelerator issues relevant to the FEL applications. As part of this study, field profile and loading measurements of higher order modes have been made on the prototype structure.

6346 (LBL–32232) **Design of rf conditioner cavities.** Govil, R.; Rimmer, R.A.; Sessler, A.; Kirk, H.G. Lawrence Berkeley Lab., CA (United States). Jun 1992. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098 ;AC02-76CH00016. (CONF-9208142–9: 14. international free electron laser conference, Kobe (Japan), 23-28 Aug 1992; ESG–184). Order Number DE93002576. Source: OSTI; NTIS; INIS; GPO Dep.

Theoretical studies are made of radio frequency structures which can be used to condition electron beams so as to greatly reduce the stringent emittance requirements for successful lasing in a free-electron laser. The basic strategy of conditioning calls for modulating an electron beam in the transverse dimension, by a periodic focusing channel, while it traverses a series of rf cavities, each operating in a TM_{210} mode. In this paper, we analyze the cavities both analytically and numerically (using MAFIA simulations). We find that when cylindrical symmetry is broken the coupling impedance can be greatly enhanced. We present results showing various performance characteristics as a function of cavity parameters, as well as possible designs for conditioning cavities.

6347 (LBL–32635) **The evolution of tooling, techniques, and quality control for accelerator dipole magnet cables.** Scanlan, R.M. Lawrence Berkeley Lab., CA (United States). Aug 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-920802–37: Applied superconductivity conference, Chicago, IL (United States), 23-28 Aug 1992). Order Number DE93002447. Source: OSTI; NTIS; INIS; GPO Dep.

The present generation of particle accelerators are utilizing the flattened, compacted, single layer cable design introduced nearly 20 years ago at Rutherford Laboratory. However, the requirements for current density, filament size, dimensional control long lengths, and low current degradation are much more stringent for the present accelerators compared with the earlier Tevatron and HERA accelerators. Also, in order to achieve higher field strengths with efficient use of superconductor, the new designs require wider cables with more strands. These requirements have stimulated an active research effort which has led to significant improvements in critical current density and conductor manufacturing. In addition they have stimulated the development of new cabling techniques, improved tooling, and better measurement techniques. The need to produce over 20 million meters of cable has led to the development of high speed cabling machines and on-line quality assurance measurements. These new developments will be discussed, and areas still requiring improvement will be identified.

6348 (LBL–32788) **Mechanical performance of full-scale prototype quadrupole magnets for the SSC.** Cortella, J.M. (Lawrence Berkeley Lab., CA (United States)); Wandesforde, A.; Devred, A. Lawrence Berkeley Lab., CA (United States). Aug 1992.

9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-920802–34: Applied superconductivity conference, Chicago, IL (United States), 23-28 Aug 1992). Order Number DE93002566. Source: OSTI; NTIS; INIS; GPO Dep.

Six 5-m-long prototype quadrupole magnets have been built and cold-tested at Lawrence Berkeley Laboratory for the Superconducting Super Collider. Each of the magnets contained instrumentation to monitor the mechanical performance of the magnets during assembly and cold-testing. In addition, the instrumentation was used along with physical measurements as aids during magnet assembly. Quantities measured include coil pressures during assembly, cooldown, and magnet energization; axial thermal contraction of the magnets during cooldown; and axial force transmitted to the magnet end-plates. For the most part, mechanical measurements have proven repeatable and agree well with analysis.

6349 (LBL–32939) **Broad-band characteristics of circular button pickups.** Barry, W.C. Lawrence Berkeley Lab., CA (United States). Oct 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (ESG–211;CONF-9210246–6: 1992 accelerator instrumentation workshop, Berkeley, CA (United States), 27-30 Oct 1992). Order Number DE93004705. Source: OSTI; NTIS; INIS; GPO Dep.

A broad-band theory of the circular button pickup is presented. Expressions for the longitudinal and transverse transfer impedance of a pair of such pickups are derived in the frequency domain. The broad-band expressions are shown to reduce to the standard electrostatic transfer functions for wavelengths large compared to the button diameter. The theory is shown to be in reasonable agreement with measurements performed on standard LEP button electrodes. In particular, the theory explains a resonance in the response of the LEP buttons which made them unsuitable, in standard form, for their intended application as pickups in the LBL Advanced Light Source feedback system. The buttons were modified to suppress the resonance and subsequently incorporated into the feedback system.

6350 (LBL–32940) **Magnetic ring for stripping enhancement.** Selph, F. Lawrence Berkeley Lab., CA (United States). Oct 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (ESG–212;CONF-9210121–4: Workshop on the production and use of intense radioactive ion beams for the IsoSpin Laboratory, Oak Ridge, TN (United States), 7-10 Oct 1992). Order Number DE93004689. Source: OSTI; NTIS; INIS; GPO Dep.

A ring designed to recycle ions through a stripping medium offers the possibility for increasing output of the desired charge state by up to 4x. This could be a very important component of a Radioactive Nuclear Beam Facility. In order for such a ring to work effectively it must satisfy certain design conditions. These include achromaticity at the stripper, a dispersed region for an extraction magnet, and a number of first and higher order optics constraints which are necessary to insure that the beam emittance is not degraded unduly by the ring. An example is given of a candidate design of a stripping ring.

6351 (LBL–32978) **A large superconducting thin solenoid for the STAR experiment at RHIC.** Green, M.A. STAR Collaboration. Lawrence Berkeley Lab., CA (United States). Jun 1992. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-920802–43: Applied superconductivity conference, Chicago, IL (United States), 23-28 Aug 1992). Order Number DE93004693. Source: OSTI; NTIS; INIS; GPO Dep.

This Report describes the 4.4 meter, warm bore diameter, thin superconducting solenoid, for the proposed STAR experiment at the Brookhaven National Laboratory. The STAR solenoid will generate a very uniform central magnetic induction of 0.5 T within a space which is 4.0 meters in diameter by 4.2 meters long. The solenoid and its cryostat will be 0.7 radiation lengths thick over a length of 5.45 meters, about the center of the magnet making it the largest solenoid less than one radiation length to be built. This report describes a proposed design for the solenoid and cryostat, its flux return iron, its cryogenic system and its power supply and quench protection system.

6352 (LBL–32981) **High power photon beamline elements in the LBL/SSRL/EXXON Beamline VI.** Hoyer, E. Lawrence Berkeley Lab., CA (United States). Sep 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-9204126–18: B factories: state of the art in accelerators, detectors, and physics, Stanford, CA (United States), 6-10 Apr 1992). Order Number DE93004701. Source: OSTI; NTIS; GPO Dep.

Beamline VI is a wiggler-based, multi-kilowatt, intense synchrotron radiation beamline installed SPEAR. The thermal design parameters for this beamline are presented and then design considerations and construction descriptions are given for many of the high-power photon beamline elements.

6353 (LBL–33068) **XUV synchrotron optical components for the Advanced Light Source: Summary of the requirements and the developmental program.** McKinney, W.; Irick, S.; Lunt, D. Lawrence Berkeley Lab., CA (United States). Jul 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-920792–45: Society of Photo-Optical Instrumentation Engineers (SPIE) international symposium on optical applied science and engineering, San Diego, CA (United States), 19-24 Jul 1992). Order Number DE93004711. Source: OSTI; NTIS; INIS; GPO Dep.

We give a brief summary of the requirements for water cooled optical components for the Advanced Light Source (ALS), a third generation synchrotron radiation source under construction at Lawrence Berkeley Laboratory (LBL). Materials choices, surface figure and smoothness specifications, and metrology systems for measuring the plated metal surfaces are discussed. Results from a finished water cooled copper alloy mirror will be used to demonstrate the state of the art in optical metrology with the Takacs Long Trace Profiler (LTP II).

6354 (SLAC-PUB–5888) **Computer codes for RF cavity design.** Ko, K. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Aug 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-9208109–66: 16. international LINAC conference, Ottawa (Canada), 23-28 Aug 1992). Order Number DE93004002. Source: OSTI; NTIS; INIS; GPO Dep.

In RF cavity design, numerical modeling is assuming an increasingly important role with the help of sophisticated computer codes and powerful yet affordable computers. A description of the cavity codes in use in the accelerator community has been given previously. The present paper will address the latest developments and discuss their applications to cavity toning and matching problems.

6355 (SLAC-PUB–5929) **Real-time on a standard UNIX workstation?.** Glanzman, T. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Sep 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-920966–4: 10. conference on computing in high energy physics, Annecy (France), 21-25 Sep 1992). Order Number DE93004009. Source: OSTI; NTIS; INIS; GPO Dep.

This is a report of an ongoing R&D project which is investigating the use of standard UNIX workstations for the real-time data acquisition from a major new experimental initiative, the SLAC B Factory (PEP II). For this work an IBM RS/6000 workstation running the AIX operating system is used. Real-time extensions to the UNIX operating system are explored and performance measured. These extensions comprise a set of AIX-specific and POSIX-compliant system services. Benchmark comparisons are made with embedded processor technologies. Results are presented for a simple prototype on-line system for laboratory-testing of a new prototype drift chamber.

6356 (SLAC-PUB–5932) **Feedback implementation options and issues for B factory accelerators.** Fox, J.D. (Stanford Linear Accelerator Center, Menlo Park, CA (United States)); Briggs, D.; Eisen, N.; Hindi, H.; Hosseini, W.; Oxoby, G.; Linscott, I.; Coiro, O.; Ghigo, A.; Serio, M.; Lambertson, G.; Voelker, F. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Sep 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (LBL–33092;CONF-9204126–15: B factories: state of the art in accelerators, detectors, and physics,

Stanford, CA (United States), 6-10 Apr 1992). Order Number DE93004011. Source: OSTI; NTIS; INIS; GPO Dep.

The proposed B factory accelerator facilities will require active feedback systems to control multibunch instabilities. These feedback systems must operate in machines with thousands of circulating bunches and with short (2–4 ns) interbunch intervals. The functional requirements for transverse (betatron) and longitudinal (synchrotron) feedback systems are presented. Several possible implementation options are discussed and system requirements developed. Conceptual designs are presented for the PEP II transverse and longitudinal feedback systems.

6357 (SLAC-PUB–5987) **A variable current bypass shunt for electromagnets.** Berndt, M.M.; Lipari, J.J. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Nov 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-921005–4: Nuclear science symposium, Orlando, FL (United States), 26-31 Oct 1992). Order Number DE93004273. Source: OSTI; NTIS; INIS; GPO Dep.

An IGBT is used to control the current in bypass circuits that vary the relative strength of magnets connected in series. Each circuit consists of a water cooled assembly rated for continuous operation at 70 Volts and 0–50 Amperes DC, with 1 KV insulation between control/monitoring elements and magnets. The circuit operates as a 10KHz PWM switcher that includes filters and transient protection.

6358 (SSCL–521) **Firming up the SSC access shafts calculations.** Baishev, I.; Mokhov, N. Superconducting Super Collider Lab., Dallas, TX (United States). Sep 1992. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. Order Number DE93004391. Source: OSTI; NTIS; INIS; GPO Dep.

A variety of the Superconducting Super Collider (SSC) access shafts are being designed to provide multi-purpose connections to the underground tunnel. The radiation levels at the top of utility and personnel shafts can exceed corresponding permissible limits even in the presence of reasonable shielding walls between the Collider tunnel and the shaft mouths. A recent calculational exploration of this problem has stimulated searches for a more acceptable layout of these shaft connections to the Collider tunnel. This paper addresses beam-loss scenarios as a source of radiation and the corresponding full-scale simulation results on attenuation properties of various sets of shielding walls at the tunnel level. Also discussed are radiation levels at the top of utility, personnel, ventilation, and delivery shafts for new layouts and updated depths.

6359 (SSCL–585) **Hybrid power supplies for the SSC Collider.** Smedley, K. Superconducting Super Collider Lab., Dallas, TX (United States). Sep 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. Order Number DE93004393. Source: OSTI; NTIS; INIS; GPO Dep.

Ripple studies show that at the drive point of the magnet string, the 720-Hz-current ripple from Silicon-Controlled Rectifier (SCR) power supplies is about 0.1022 mA during the injection period and 0.0648 mA during the holding period. An emittance growth was observed when the ripple was introduced to the collider particle motion simulation code. The emittance growth is especially serious during the injection period. What is an alternative power supply topology that provides high current and low ripple, yet has good reliability and reasonable cost? A hybrid power supply topology is proposed in this paper.

6360 (SSCL–586) **Ripple distribution in magnet strings of the SSC Collider.** Smedley, K.; Jayasuriya, A.; Christiansen, C.; Shafer, R. Superconducting Super Collider Lab., Dallas, TX (United States). Sep 1992. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. Order Number DE93004389. Source: OSTI; NTIS; INIS; GPO Dep.

With a circumference of 87 km, the Superconducting Super Collider (SSC) main collider ring will have a revolution frequency of 3.4 kHz. The fractional part of the betatron oscillation will be near the power supply ripple frequencies (720 Hz and its sub/superharmonics), assuming 12-pulse Silicon-Controlled Rectifier (SCR) power supplies are used. The Collider is powered by ten power supply units in ten sections along the ring. Each section will have an average length of about 8.7 km. The voltage ripple in the power supply generates ripple current in the magnet coil that, in turn, generates ripple in the magnetic field of dipoles and quadrupoles. The ripple in the magnetic field will be a function of time and space due to the transmission line effect. The work reported in this paper gives a thorough analysis of the differential mode ripple distribution in the magnet string of the collider standard arc.

6361 (SSCL–593) **Quench simulation for the 40-mm-aperture Collider Quadrupole Magnet for the SSC.** Lopez, G. Superconducting Super Collider Lab., Dallas, TX (United States). Sep 1992. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. Order Number DE93004392. Source: OSTI; NTIS; INIS; GPO Dep.

Using the computer program SSCQ-RR, which is a modification of the program SSC-RR, the quench propagation in a 40-mm-aperture Collider Quadrupole Magnet (CQM) at an initial current of 6500 A is studied. Single quadrupole passive protection is analyzed. The active protection system is examined when this magnet is connected in series with a given number of 50-mm-aperture dipole magnets. The result of the single CQM passive protection simulations agrees with the experimental observation that the CQM is self-protected. The results of the active protection system simulations show that the original Site-Specific Conceptual Design Review (SCDR) active protection system is completely safe with or without heaters in the quadrupole, providing that the heater time delay τ_{th} is less than 150 ms.

6362 (SSCL-Preprint–147) **Papers contributed to the 1992 applied superconductivity conference.** Superconducting Super Collider Lab., Dallas, TX (United States). Aug 1992. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-920802–: Applied superconductivity conference, Chicago, IL (United States), 23-28 Aug 1992). Order Number DE93000836. Source: OSTI; NTIS; INIS; GPO Dep.

This report contains papers reporting on the mechanical and physical performance of superconducting magnets for the superconducting super collider.

6363 (SSCL-Preprint–175) **SSCL DD2 mass storage.** Mestad, S.L. Superconducting Super Collider Lab., Dallas, TX (United States). Sep 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-920966–18: 10. conference on computing in high energy physics, Annecy (France), 21-25 Sep 1992). Order Number DE93004458. Source: OSTI; NTIS; INIS; GPO Dep.

The SSCL detector collaboration have determined the lab will need data storage devices capable of handling data rates of 100 megabytes/second and storing several petabytes per year. These needs would be difficult to meet with the typical devices currently available. A new high speed, high density tape drive has bee integrated with an SGI system at the SSCL which is capable of meeting the detector data storage requirements. This paper describes the goals and stages of the integration project, the lessons learned, and the additional work planned to make effective use of the DD2 tape drive.

6364 (UCRL-JC–110847) **High-bandwidth, high-dynamic-range, analog optical guided-wave systems for physics instrumentation.** Lowry, M.; Haigh, R.; Hugenberg, K.; Masquelier, D.; McConaghy, C.; McCammon, K.; Nelson, D.; Roeske, F. Lawrence Livermore National Lab., CA (United States). Jul 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9207162–1: Broadband analog and digital opto-electronics, Santa Barbara, CA (United States), 29-31 Jul 1992). Order Number DE93001619. Source: OSTI; NTIS; GPO Dep.

We have developed two remote measurement systems that efficiently exploit the information transmission capacity of optical guided-wave technology. The first system, which operates at 820 nm, was developed for nuclear weapons measurements and emphasizes high-bandwidth high-dynamic range information transmission. The second system was developed for the detector readout at the Super-Conducting Super Collider (SSC); this system emphasizes high charge sensitivity measurement transmission and operates at 1320 nm. Most of the component design (including

modeling), fabrication, packaging, characterization, and system integration was done at LLNL specifically for these specialized physics measurements applications.

6365 (UCRL-JC–111197) **Line-of-sight injection into a tandem accelerator.** Bertsche, K.J. Lawrence Livermore National Lab., CA (United States). Oct 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-921116–10: 12. international conference on the application of accelerators in research and industry, Denton, TX (United States), 2-5 Nov 1992). Order Number DE93002889. Source: OSTI; NTIS; INIS; GPO Dep.

A beamline has been designed to accommodate an AMS ion source the O° position, injecting in a straight line into the Livermore CAMS tandem accelerator. An AMS source at this position will allow simultaneous injection of isotopes, providing a testbed for injection techniques which may be used in a low cost RFQ accelerator for tritium AMS measurements. The use of a Wien filter in the beamline will also allow selection of individual isotopes, with the capability of rapid sequential injection of isotopes. The stable isotope current may be collected in a Faraday cup while the radioisotope is injected into the tandem, allowing continuous monitoring of ion source output,for calibration purposes. This Wien filter and injection beamline should be adequate for biomedical measurements of ^{14}C as well as for tritium.

6366 (UM-P–91/50) **Measurement of the spatial coherence of a soft x-ray laser.** Trebes, J.E. (Lawrence Livermore National Lab., CA (United States)); Mrowka, S.; London, R.A.; Barbee, T.W.; Carter, M.R.; MacGowan, B.J.; Matthews, D.L.; Da Silva, L.B.; Stone, G.F.; Feit, M.D.; Nugent, K.A. Melbourne Univ., Parkville, VIC (Australia). School of Physics. [1991]. [11] Sponsored by USDOE, Washington, DC (United States). Contract W-7405-ENG-48. Order Number DE93609404. Source: OSTI; NTIS (US Sales Only); INIS.

The spatial coherence of a neon-like selenium x-ray laser operating at 206 and 210 Angstroems has been measured using a technique based on partially coherent x-ray diffraction. The time integrated spatial coherence of the selenium x-ray laser was determined to be equivalent to that of a quasi-monochromatic spatially incoherent disk source whose diameter is comparable to the line focus of the visible light laser pumping the x-ray laser. The spatial coherence was improved by narrowing the line focus width. 20 refs., 4 figs.

6367 (UM-P–91/97) **An electrostatic mirror for neutral polar molecules.** Wark, S.J.; Opat, G.I. Melbourne Univ., Parkville, VIC (Australia). School of Physics. [1992]. [30] Sponsored by Australian Research Council, Canberra, ACT (Australia). Order Number DE93609405. Source: OSTI; NTIS (US Sales Only); INIS.

An electrostatic mirror for neutral polar molecules has been constructed using an array of electrodes of alternating polarity between which a high potential was applied. This configuration produces an exponentially evanescing electric field that interacts with polar molecules by the Stark effect. The spatial gradients of the Stark energies produce forces which were used to reflect a pulsed beam of chloromethane (CH_3Cl) molecules with a reflectivity of 25% at grazing angles of incidence of around 5 mrad. Reflections have also been produced with applied voltages as low as 100 V or with grazing angles greater than 20 mrad. This type of device could be useful for the manipulation of slow molecular beams and would permit the construction of optical elements for the de Broglie waves of molecules. 13 refs., 11 figs.

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Refer also to citation(s) 6279, 6440

6368 (DESY–92-121) **Introduction to radiation backgrounds in a B factory.** Khan, S. (Max-Planck-Inst. fuer Kernphysik, Heidelberg (Germany)). Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). Aug 1992. 11p. (CONF-9204126–: B factories: state of the art in accelerators, detectors, and physics, Stanford, CA (United States), 6-10 Apr 1992). Order Number DE93742848. Source: OSTI; NTIS (US Sales Only); INIS.

Detector backgrounds in a B factory due to synchrotron radiation and beam-gas interactions are discussed and the computational tools to simulate these processes are outlined. As an example of their application, simulations and beam tests that preceded the installation of the ARGUS silicon vertex detector are described. (orig.).

6369 (INIS-mf–14106) **BESSY annual report 1991.** Berliner Elektronenspeicherring-Gesellschaft fuer Synchrotronstrahlung mbH (BESSY), Berlin (Germany). 1992 599p. (In German). Order Number DE93750860. Source: OSTI; NTIS (US Sales Only); INIS.

The annual report 1991 is drawn up as in the previous years, with general information on the organisational structure of the institution and its general purposes being given ahead of the research-specific reports. The achievements and developments in the fields of machines and experiments are reported, including contributions from the Litography laboratory of the Fraunhofer Institute for Microstructural Studies and Techniques, and from the Radiometry Laboratory of the Physikalisch-Technische Bundesanstalt, followed by reports on basic research work. The machine developments are reported in varions contributions, and a list of publications shows all available and known scientific publications resulting from research work done at the BESSY installations by the various users. Diploma, doctoral and habilitation theses are listed separately. (orig.).

6370 (INS–931) **The space charge effects on the slow extraction process.** Ohmori, Chihiro. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Jun 1992. 9p. Order Number DE93754287. Source: OSTI; NTIS; INIS.

The calculation of the slow extraction which includes the space charge effects has been performed for the Compressor/Stretcher Ring (CSR) of the proposed Japanese Hadron Project. We have investigated the slow extraction of 1 GeV proton beam with an average current of 100μA. Calculation shows not only the emittance growth of the extracted beam but also decrease of the extraction efficiency and discontinuity of beam spill. (author).

6371 (IYaF–90-102) **Electron cooling: physics and prospects for using.** Parkhomchuk, V.V.; Skrinskij, A.N. AN SSSR, Novosibirsk (Russian Federation). Inst. Yadernoj Fiziki. 1990. [43] (In Russian). Order Number DE93609425. Source: OSTI; NTIS (US Sales Only); INIS.

Review of the current state of the electron cooling method is given. Its physical principles are descibed. Methods of experimental investigation and possible spheres of electron cooling application are enumerated. 39 refs.

6372 (IYaF–90-129) **Parameters of TNK electron storage as a synchrotron radiation source.** Valentinov, A.G.; Korchuganov, V.N.; Kulipanov, G.N.; Levichev, E.B.; Ushakov, V.A. AN SSSR, Novosibirsk (Russian Federation). Inst. Yadernoj Fiziki. 1990. [24] (In Russian). Order Number DE93609426. Source: OSTI; NTIS (US Sales Only); INIS.

The TNK electron storage ring with electron energy of 1-2 GeV is a specialized synchrotron radiation (SR) source designed for solving the problems of submicron technology and conducting various investigations within 0.2-2000 A have length range. Basic user characteristics (spectral luminosity, photon fluxes radiation power etc.) of the TNK SR are presented. 4 refs.; 17 figs.

6373 (LBL–32559) **PEP-II asymmetric B Factory: Design update and R&D results.** Zisman, M.S. (Lawrence Berkeley Lab., CA (United States)); Bell, R.A.; Dorfan, J.; Schwarz, H.; Barletta, W.A.; Calderon, M. Lawrence Berkeley Lab., CA (United States). Jul 1992. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098 ;AC03-76SF00515 ;W-7405-ENG-48. (ESG–206;SLAC-PUB–5852;ABC–76;UCRL-JC–111380;CONF-920706–46: International conference on high energy accelerators, Hamburg (Germany), 20-24 Jul 1992). Order Number DE93004772. Source: OSTI; NTIS; INIS; GPO Dep.

PEP-II, a 9 GeV x 3.1 GeV e^+e^- collider with a design luminosity of 3 x 10^{33} $cm^{-2}_{e}{}^{-1}$, was proposed jointly by SLAC, LBL, and LLNL. Recent efforts have continued towards an optimized design. In addition, an aggressive R&D program is under way to validate our design choices. Fabrication of a low-power prototype RF cavity

is complete, and impedance measurements are beginning. A 500-kW, 476-MHz klystron has been completed; it will be used for testing both high-power RF windows and a prototype high-power cavity (now under design in collaboration with Chalk River Laboratory). Vacuum studies have demonstrated that chambers with suitable photodesorption properties can be fabricated. A mockup of the two-ring arc area has been completed and used to investigate alignment and stability issues. The PEP-II project is ready to begin construction as soon as funds become available.

6374 (SLAC-PUB–5936) **PEP 2: SLAC-based Asymmetric B Factory.** Fieguth, T. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Sep 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-920837–13: ICHEP-26: 26th International Union of Pure and Applied Physics (IUPAP) conference on high energy physics, Dallas, TX (United States), 6-12 Aug 1992). Order Number DE93004012. Source: OSTI; NTIS; INIS; GPO Dep.

The proposal for upgrading the existing PEP collider at SLAC to enable the copious production of boosted B mesons is the result of several years of collaborative study by groups representing LBL, LLNL and SLAC. The PEP II design has evolved in a considered fashion from its initial conceptualization to a very advanced level of understanding, well-substantiated by R&D results on the key design issues. We describe the proposed upgrade, review the early conceptual decisions, outline the significant remaining questions, and briefly describe current results from the ongoing R&D effort which have shown these questions to be tractable and the initial concepts to be sound.

44 INSTRUMENTATION

Refer also to citation(s) 5822

4401 Radiation Instrumentation

Refer also to citation(s) 5206, 6082, 6307, 6308, 6310, 6318, 6332, 6333, 6439, 6440, 6834, 6840, 6854, 6856, 6915, 6939, 6940, 6950, 6952, 6964, 6986

6375 (ANL-HEP-CP–92-80) **The SDC central calorimeter.** Proudfoot, J. The SDC Collaboration. Argonne National Lab., IL (United States). [1992]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9209263–4: 3. international conference on calorimetry in high energy physics, Corpus Christi, TX (United States), 29 Sep - 2 oct 1992). Order Number DE93002986. Source: OSTI; NTIS; INIS; GPO Dep.

An overview of the calorimeter being designed and constructed by Solenoidal Detector Collaboration (SDC) for use at the Superconducting SuperCollider is presented. The collaboration have chosen to build a sampling calorimeter using scintillating tile with wavelength-shifter fiber readout as the detector medium, and absorber media of lead and iron for the electromagnetic and hadronic compartments. This choice was based on a substantial amount of R&D and Monte Carlo simulation calculations, which showed that it both met the necessary experimental specifications in addition to being a cost effect design.

6376 (ANL-HEP-CP–92-94) **Some fiber-tile optical studies for SDC electromagnetic calorimeter.** Underwood, D.G. Argonne National Lab., IL (United States). High Energy Physics Div. [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9209263–2: 3. international conference on calorimetry in high energy physics, Corpus Christi, TX (United States), 29 Sep - 2 oct 1992). Order Number DE93002781. Source: OSTI; NTIS; INIS; GPO Dep.

A number of different issues have been studied at Argonne for development of the fiber-tile optical system for SDC EM. Results on uniformity, masking and wrapping, beveled tiles, timing, fiber damage, and pressure on the scintillator are presented. The instrumentation and techniques are also briefly discussed.

6377 (ANL-HEP-CP–92-95) **The electromagnetic calorimeter for the STAR experiment at RHIC.** Underwood, D.G. Argonne National Lab., IL (United States). High Energy Physics Div. [1992]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9209263–3: 3. international conference on calorimetry in high energy physics, Corpus Christi, TX (United States), 29 Sep - 2 oct 1992). Order Number DE93002780. Source: OSTI; NTIS; INIS; GPO Dep.

The STAR detector at RHIC can be used both for searches for quark-gluon plasma and for high energy pp spin physics. An electromagnetic calorimeter is being planned which will be used for triggering on High pt direct gammas, $e^{\pm}$, and the electromagnetic component of jets. Jets will be measured for both kinds of physics by using the electro-magnetic calorimeter and central TPC tracking. We describe some features of the fiber-tile calorimeter as it is presently being designed.

6378 (ANL-HEP-TR–92-97) **Effect of Pb and air absorber thickness on ^{137}Cs signal.** Jankowski, D.; Lopiano, D.; Stanek, R. Argonne National Lab., IL (United States). 22 Oct 1992. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (SDC–92-350). Order Number DE93002783. Source: OSTI; NTIS; INIS; GPO Dep.

We present the results of a measurement to understand the effects of transverse misplacement of the ^{137}Cs source tube inside the cast Pb plates of the SDC EMC calorimeter. The PMT current from a scintillator was measured as the ^{137}Cs source was displaced by varying thicknesses of Pb, as well as varying thicknesses of air gap. At a nominal depth of 2 mm in Pb, we find a change in scintillator output of about 25%/mm, and about 10%/mm of air gap. The data are compared to a simple calculation. By taking the sum of the scintillators on top and below a source tube, we estimate a source tube displacement of $\pm 450\mu$ will cause an error in the PMT output by 1%.

6379 (ANL/RE/CP–76730) **APSTNG: Neutron interrogation for detection of drugs and other contraband.** Rhodes, E. (Argonne National Lab., IL (United States). Reactor Engineering Div.); Peters, C.W. Argonne National Lab., IL (United States). Reactor Engineering Div. [1992]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9210215–1: Contraband and cargo inspection technology, Washington, DC (United States), 28-30 Oct 1992). Order Number DE93002919. Source: OSTI; NTIS (US Sales Only); GPO Dep.

A recently developed neutron diagnostic probe system has the potential to satisfy van-mobile and fixed-portal requirements for nondestructive detection, including monitoring Of contraband drugs, explosives, and nuclear and CW weapon materials, and treaty verification of seated munitions. The probe is based on a unique associated-particle sealed-tube neutron generator (APSTNG) that interrogates the object of interest with a low-intensity beam of 14-MeV neutrons generated from the deuterium-tritium reaction and detects the alpha-particle associated with each neutron. Gamma-ray spectra of resulting neutron reactions identify@ nuclides associated with drugs, explosives, and other contraband. Flight times determined from detection times of the gamma-rays and alpha-particles yield a separate coarse tomographic image of each identified nuclide. The source and emission detection systems can be located on the same side of the interrogated volume, allowing measurements with access to one side only. The APSTNG also forms the basis for a compact fast-neutron transmission imaging system. For cost-effective interrogation of large trucks and cargo containers, a three-stage approach is proposed, combining APSTNG and gamma-ray (isotopic source) transmission hodoscopes, a gantry APSTNG emission system, and a small multisensor system (containing an APSTNG emission system) for offloaded cargo. Proof-of-concept experiments have been performed under laboratory conditions. The small and relatively inexpensive APSTNG exhibits high reliability and can be quickly replaced. Surveillance systems based on APSTNG technology can avoid the large physical size, high capital and operating expenses, and reliability problems of complex accelerators.

6380 (BNL–48005) **Monolithic preamplifier employing epitaxial N-channel JFETs.** Radeka, V. (Brookhaven National Lab., Upton, NY (United States)); Rescia, S.; Manfredi, P.F.; Re, V.; Speziali, V. Brookhaven National Lab., Upton, NY (United States). Feb 1992. 14p. Sponsored by USDOE, Washington, DC (United

States). DOE Contract AC02-76CH00016. (CONF-9202140–1: 6. European symposium on semiconductor detectors: new developments on radiation detectors, Milan (Italy), 24-26 Feb 1992). Order Number DE93002951. Source: OSTI; NTIS; INIS; GPO Dep.

This paper reports the results obtained in the research program oriented to the realisation of a monolithic preamplifier for calorimetry applications at high luminosity colliders. The main purpose of the program is to arrive at a monolithic realisation with a performance as close as possible to that of discrete preamplifiers. The junction field-effect transistors employed in discrete preamplifiers have an epitaxial channel and a very heavily doped gate diffused onto it. They present the best noise and radiation tolerance characteristics. The first step in the program implementation was, accordingly, the search for a process able to make the integration of epitaxial-channel. JFETs on a monolithic substrate possible. The integration has been accomplished on the basis of a buried-layer approach to device isolation. Individual JFETs and a complete preamplifier employing only N-channel JFETs have been realised. The characterisation of the individual devices has shown that their behaviour in terms of small signal and noise parameters is very close to that of their discrete equivalents. This result, along with the very good noise performances of the preamplifier, seems to point out that the buried layer process has fulfilled the task for which it was developed.

6381 (CDTN-DETS-NI–005/89) **Potentiality evaluation of the MAT 250 UF mass spectrometer for general analysis.** Barros Filho, J.A.; Silva Maia, N. da. Centro de Desenvolvimento da Tecnologia Nuclear (CDTN), Belo Horizonte, MG (Brazil). Oct 1989. [43] (In Portuguese). Order Number DE93609499. Source: OSTI; NTIS (US Sales Only); INIS.

This work presents a study on the potentiality of the MAT 250 UF mass spectrometer. It was formerly used only, for uranium isotopic analysis. It will be used, flow now on, also for the analysis of other gases such as deuterium, helium and hydrogen, as well. (A.C.A.S.).

6382 (CONF-8909210–, pp. 615-631) **Track structure: Perspectives, progress, problems.** Katz, R. (Univ. of Nebraska, Lincoln (United States)). Oak Ridge National Lab., TN (United States). Apr 1990. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

Heavy ions interact with detectors largely through the agency of secondary electrons called delta rays, whose influence is best described through the radial distribution of the dose they deposit. Monte Carlo calculations of the radial dose distribution from protons in liquid water (Hamm), approximated analytically on the basis of a calculation using electron range energy relations in aluminum and the Rutherford formula for delta ray production with normal electron ejection, and extended to heavy ions by a formula for effective charge (Barkas), compare well with recent measurements (Meting) of the average dose distribution from half clad U ions in gas. The author extends his calculations to several solids (NaI, LiF, Si, SiO_2) by weighting for electron density and adjusting the radial dose formula so that its integral agrees with tabulated stopping power values (Janni) at all proton speeds.

6383 (CONF-920480–2) **Physics studies with ICARUS and a hybrid ionization and scintillation fiber detector.** Cline, D.B. California State Univ., Los Angeles, CA (United States). Dept. of Physics and Astronomy. [1992]. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-91ER40662. From International conference on liquid radiation detectors (ICLRD): their fundamental properties and applications; Tokyo (Japan); 7-10 Apr 1992. Order Number DE93003034. Source: OSTI; NTIS; INIS; GPO Dep.

We discuss the physics possibilities for the ICARUS detector currently being tested at CERN. The physics potential goes from a massive proton decay detector to the study of solar neutrinos. In addition, the detection of $\nu_\mu \rightarrow \nu_\tau$ and $\nu_e \rightarrow \nu_\tau$ will be possible with such a detector. One major topic involves the possibility of a complete determination of the MSW solar neutrino parameters with the ICARUS. The possibility of detecting WIMPS with a scintillating fiber liquid Argon (Ar) detector or fiber Xenon (Xe) detector doped with Ar is also described. Some comments on the measurement of the ^{42}Ar level from an experiment at the Gran Sasso will be made.

6384 (CONF-920966–10) **Feasibility of using neural networks as a level 2 calorimeter trigger for jet tagging.** Handler, T. (Tennessee Univ., Knoxville, TN (United States). Dept. of Physics); Neis, E.; Glover, C.; Gabriel, T.; Saini, S. Oak Ridge National Lab., TN (United States). [1992]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 10. conference on computing in high energy physics; Annecy (France); 21-25 Sep 1992. Order Number DE93003016. Source: OSTI; NTIS; INIS; GPO Dep.

Several of expected decay modes of the Higgs particle will result in jet formation. We propose to incorporate a second level trigger into the SDC detector, using neural network VSLI hardware, to tag such Higgs decay modes. The input to the neural network will be the energy depositions in both the barrel and endcap regions of the calorimeter. The neural network's output would be a value representing the degree of correlation between the observed energy distribution and the type of physical scattering that has occurred. Preliminary results indicate that neural networks may be of use in tagging jet decays of the Higgs particle.

6385 (CONF-920966–11) **Charged particle track reconstruction using artificial neural networks.** Glover, C. (Oak Ridge National Lab., TN (United States)); Fu, P.; Gabriel, T.; Handler, T. Oak Ridge National Lab., TN (United States). [1992]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 10. conference on computing in high energy physics; Annecy (France); 21-25 Sep 1992. Order Number DE93003014. Source: OSTI; NTIS; INIS; GPO Dep.

This paper summarizes the current state of our research in developing and applying artificial neural network (ANN) algorithm described here is based on a crude model of the retina. It takes as input the coordinates of each charged particle's interaction point ("hit") in the tracking chamber. The algorithm's output is a set of vectors pointing to other hits that most likely to form a track.

6386 (CONF-921005–5) **Design and characterization of the BVX: An 8-channel CMOS preamplifier-shaper for silicon strips.** Britton, C.L. Jr. (Oak Ridge National Lab., TN (United States)); Alley, G.T.; Simpson, M.L.; Wintenberg, A.L.; Yarema, R.J.; Zimmerman, T.; Boissevain, J.; Collier, W.; Jacak, B.V.; Simon-Gillo, J.; Sondheim, W.; Sullivan, J.P.; Lockyer, N. Oak Ridge National Lab., TN (United States). [1992]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Nuclear science symposium; Orlando, FL (United States); 26-31 Oct 1992. Order Number DE93003619. Source: OSTI; NTIS; GPO Dep.

This paper presents the design and characterization of an 8channel preamplifier-shaper intended for use with silicon strip detectors ranging in capacitance from 1 to 20pF. The nominal peaking time of the circuit is 200ns with an adjustment range of ±50ns. The circuit has a pitch (width) of 84μchannel with a power dissipation of 1.2mW/channel and has been fabricated in 2μm p-well CMOS. The 0pF noise is 330e with a noise slope of 64e/pF. The design approach is presented as well as both test bench and strip detector measurements.

6387 (DOE/ER/40372–3) **Scintillating fiber detection development for the SSC: Annual report.** Ruchti, R. Notre Dame Univ., IN (United States). Dept. of Physics. [1993]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-87ER40372. Order Number DE93005576. Source: OSTI; NTIS; INIS; GPO Dep.

SSC Detector Program at Notre Dame has been concentrating on the development of scintillating fiber detectors for tracking applications. Initial work has focused on the development of new scintillation materials for micro-tracking and central tracking detectors based on organic plastics and liquids, This effort has included studies of solvents, solutes and waveguides. Techniques capable of providing the detection of single photons from fibers, are also being developed, leading to a collaboration with Rockwell, UCLA, and UTexas-Dallas groups on the development and application of the Solid State Photomultiplier (SSPM). This initial collaboration

has been strengthened and expanded to the formation of a larger collaboration whose goal is to develop a fiber tracking subsystem for SSC, incorporating scintillating fibers and solid state photodetectors. The major subsystem proposal submitted to SSCL by this new collaboration, known at the Fiber Tracking Group (FTG), has been approved and funding is being put in place. The collaboration consists of 12 institutions and Notre Dame is a spokesman group.

6388 (DOE/ER/40579–T1) **Development of a scintillating fiber tracker for the SSC: Final technical report, July 1, 1990–June 30, 1991.** Lewis, R.A. Pennsylvania State Univ., University Park, PA (United States). Oct 1991. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-90ER40579. Order Number DE93000937. Source: OSTI; NTIS; INIS; GPO Dep.

The Fiber Tracking Group (FTG) of the Solenoidal Detector Collaboration (SDC) is developing a high-rate tracking subsystem appropriate for the SDC detector based on scintillating fiber technology. The use of scintillating fibers as a detection medium affords the prospect for tracking particles with high resolution, low occupancy, and very short resolving time. The near term objective of FTG is to develop a prototype detector with up to 10^4 fibers for beam tracking tests to determine the utility of the technique. The Penn State University group has been working on event simulations. The main challenge confronting the tracking detector is to identify events containing high PT leptons in a high luminosity environment. Problems addressed to date include high PT resolution, backgrounds, and pileup. In addition, recently the design of trigger-specific readout electronics has been addressed. Current results from these activities are reported.

6389 (FNAL/C–92/263-E) **Operation of the CDF Silicon Vertex Detector with colliding beams at Fermilab.** Bedeschi, F. (Scuola Normale Superiore, Pisa (Italy)); Bolognesi, V.; Dell'Agnello, S.; Galeotti, S.; Grieco, G.; Mariotti, M.; Menzione, A.; Punzi, G.; Raffaelli, F.; Ristori, L.; Tartarelli, F.; Turini, N.; Wenzel, H.; Zetti, F.; Bailey, M.W.; Garfinkel,Fermi National Accelerator Lab., Batavia, IL (United States). Oct 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-920837–33: ICHEP-26: 26th International Union of Pure and Applied Physics (IUPAP) conference on high energy physics, Dallas, TX (United States), 6-12 Aug 1992). Order Number DE93004411. Source: OSTI; NTIS; INIS; GPO Dep.

In this paper we briefly describe the main features of the CDF Silicon Vertex Detector (SVX) and discuss its performance during actual colliding beam operation at the Fermilab Tevatron. Details on S/N ratio, alignment, resolution and efficiency are given.

6390 (FNAL/C–92/273) **The e/π and π^0/π ratios measured, and monochromatic γ and π^0 beams explored in the D0 test calorimeter.** Tartaglia, M.A. D0 Collaboration. Fermi National Accelerator Lab., Batavia, IL (United States). Oct 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-9206222–4: International conference on advanced technology and particle physics, Como (Italy), 22-26 Jun 1992). Order Number DE93004414. Source: OSTI; NTIS; INIS; GPO Dep.

The e/π response ratio of the DO end calorimeter has been measured by comparing data from 10 to 150 GeV/c electron and pion beams. The "intrinsic" e/π of the fine-hadronic module has also been studied with the pions alone, by selecting π^0-like showers contained within individual layers of the calorimeter. The measurements are compared to GEANT Monte Carlo simulations. A technique to generate monochromatic test beams of photons and neutral pions was successfully investigated. Preliminary results from central calorimeter modules exposed to these beams are discussed, and are compared to calculated expectations.

6391 (FNAL/C–92/274) **The D0 experiment at Fermilab.** Heintz, U. (Columbia Univ., Irvington-on-Hudson, NY (United States). Nevis Labs.). D0 Collaboration. Fermi National Accelerator Lab., Batavia, IL (United States). Oct 1992. 8p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-9206322–1: 4. topical seminar on the standard model and just beyond, San Miniato (Italy), 1-5 Jun 1992). Order Number DE93004415. Source: OSTI; NTIS; INIS; GPO Dep.

The D0 experiment at Fermilab is described. The detector is complete and presently taking physics data. Results from beam tests of the calorimeter and an outline of the physics agenda for the present run are also given.

6392 (FNAL/C–92/275) **Addition of photosensitive dopants to the D0 liquid argon calorimeter.** Amos, N.A.; Anderson, D.F. The D0 Collaboration. Fermi National Accelerator Lab., Batavia, IL (United States). Oct 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-9206222–5: International conference on advanced technology and particle physics, Como (Italy), 22-26 Jun 1992). Order Number DE93004416. Source: OSTI; NTIS; INIS; GPO Dep.

The addition of photosensitive dopants to liquid argon greatly enhances the signal from heavily ionizing particles. Since binding energy losses we correlated with the heavily ionizing component in hadronic showers, the addition of photosensitive dopants has been suggested as a mechanism to tune the e/π ratio in liquid argon calorimeters. A measurement was performed at the FNAL test beam, adding 4 ppM tetramethylgermanium to the Dϕ uranium-liquid argon calorimeter. An increase in response for electromagnetic and hadronic showers was observed, with no net change in the e/π ratio.

6393 (FNAL/C–92/276) **The D0 upgrade.** Tuts, P.M. (Columbia Univ., New York, NY (United States). Physics Dept.). The D0 Collaboration. Fermi National Accelerator Lab., Batavia, IL (United States). Oct 1992. 10p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-9206222–6: International conference on advanced technology and particle physics, Como (Italy), 22-26 Jun 1992). Order Number DE93004417. Source: OSTI; NTIS; INIS; GPO Dep.

The original D0 detector was proposed in 1983, with a focus on high P_T physics using precision measurements of e's, μ's, jets, and missing E_T. This detector, as of the summer of 1992, has started data taking at the Fermilab Collider. However, by 1995/6 the luminosity will reach 10^{31} $cm^{-2}sec^{-1}$, and the minimum bunch spacing will drop to 396ns from the present 3.5μs (by the Main Injector era, luminosities will approach 10^{32} $cm^{-2}sec^{-1}$ and minimum bunch spacings may reach 132ns). These changes in the accelerator conditions force us to upgrade or replace a number of detector subsystems in order to meet these new demands. In addition, the upgrade offers us the opportunity to expand the physics horizons to include not only the all important high P_T physics menu, but also the low P_T physics that has become increasingly important. In this paper we describe the D0 detector upgrade.

6394 (FNAL/C–92/283) **Drift chamber tracking with neural networks.** Lindsey, C.S.; Denby, B.; Haggerty, H. Fermi National Accelerator Lab., Batavia, IL (United States). Oct 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-921005–16: Nuclear science symposium, Orlando, FL (United States), 26-31 Oct 1992). Order Number DE93004420. Source: OSTI; NTIS; INIS; GPO Dep.

We discuss drift chamber tracking with a commercial log VLSI neural network chip. Voltages proportional to the drift times in a 4-layer drift chamber were presented to the Intel ETANN chip. The network was trained to provide the intercept and slope of straight tracks traversing the chamber. The outputs were recorded and later compared off line to conventional track fits. Two types of network architectures were studied. Applications of neural network tracking to high energy physics detector triggers is discussed.

6395 (FNAL/C–92/305) **The D0 muon system and early results on its performance.** Hedin, D. (Northern Illinois Univ., De Kalb, IL (United States). Dept. of Physics). The D0 Collaboration. Fermi National Accelerator Lab., Batavia, IL (United States); Northern Illinois Univ., De Kalb, IL (United States). Dept. of Physics. Oct 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-920837–27: ICHEP-26: 26th International Union of Pure and Applied Physics (IUPAP) conference on high energy physics, Dallas, TX (United States), 6-12 Aug 1992). Order Number DE93004745. Source: OSTI; NTIS; INIS; GPO Dep.

The D0 detector is a large, general-purpose detector designed to take full advantage of the 2 TeV energy of the Fermilab collider. The design of the experiment emphasizes accurate identification, complete angular acceptance, and precise measurement of the decay products of W and Z bosons: charged leptons (both electrons and muons), quarks and gluons, which emerge as collimated jets of particles, and noninteracting particles, such as neutrinos. The primary physics goals of D0 include searching for new phenomena, such as the top quark or particles outside the standard model, and high-precision studies of the W and Z bosons. In addition, the excellent muon identification will allow the study of b-quark production and decay. This report will describe D0's muon system, give preliminary measurements of chamber and trigger rates, and discuss muon identification.

6396 (FNAL/C–92/306) **The D0 Monte Carlo.** Womersley, J. (Florida State Univ., Tallahassee, FL (United States). Dept. of Physics). Fermi National Accelerator Lab., Batavia, IL (United States); Florida State Univ., Tallahassee, FL (United States). Dept. of Physics. Oct 1992. 8p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-920837–26: ICHEP-26: 26th International Union of Pure and Applied Physics (IUPAP) conference on high energy physics, Dallas, TX (United States), 6-12 Aug 1992). Order Number DE93004746. Source: OSTI; NTIS; INIS; GPO Dep.

The D0 detector at the Fermilab Tevatron began its first data taking run in May 1992. For analysis of the expected 25 pb^{-1} data sample, roughly half a million simulated events will be needed. The GEANT-based Monte Carlo program used to generate these events is described, together with comparisons to test beam data. Some novel techniques used to speed up execution and simplify geometrical input are described.

6397 (FNAL/C–92/307) **Tests of the D0 calorimeter response in 2–150 GeV beams.** De, K. (Michigan Univ., Ann Arbor, MI (United States). Dept. of Physics). D0 Collaboration. Fermi National Accelerator Lab., Batavia, IL (United States). Oct 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-920837–29: ICHEP-26: 26th International Union of Pure and Applied Physics (IUPAP) conference on high energy physics, Dallas, TX (United States), 6-12 Aug 1992). Order Number DE93004747. Source: OSTI; NTIS; INIS; GPO Dep.

At the heart of the D0 detector, which recently started its maiden data run at the Fermilab Tevatron $p\bar{p}$ collider, is a finely segmented hermetic large angle liquid argon calorimeter. We present here results from the latest test beam studies of the calorimeter in 1991. Modules from the central calorimeter, end calorimeter and the inter-cryostat detector were included in this run. New results on resolution, uniformity and linearity will be presented with electron and pion beams of various energies. Special emphasis will be placed on first results from the innovative technique of using scintillator sampling in the intermediate rapidity region to improve uniformity and hermeticity.

6398 (FNAL/C–92/316) **Design of an advanced readout chip for silicon strip detectors.** Zimmerman, T.; Sarraj, M.; Yarema, R. Fermi National Accelerator Lab., Batavia, IL (United States). Nov 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-921005–15: Nuclear science symposium, Orlando, FL (United States), 26-31 Oct 1992). Order Number DE93004750. Source: OSTI; NTIS; INIS; GPO Dep.

Work was begun in 1990 on the development of an advanced readout chip (ARC) for silicon strip detectors. Features of the proposed device include compatibility with close bunch spacing and double sided detectors, and on chip analog storage, digitization, and data sparsification. Chip have been designed to check all of these concepts, fabricated in the VTI 2 micron process, and tested. The circuit configurations and test results are presented in this paper.

6399 (FNAL-TM–1798) **A study of the Intel ETANN VLSI neural network for an electron isolation trigger.** Lindsey, C.S.; Denby, B. Fermi National Accelerator Lab., Batavia, IL (United States). Oct 1992. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. Order Number DE93004713. Source: OSTI; NTIS; INIS; GPO Dep.

A neural network circuit structure was previously proposed for making an isolated electron trigger for the CDF plug calorimeter. Here we discuss a study of the isolation performance of the Intel ETANN (Electrically Trainable Analog Neural Network) chip. We used the PC based ETANN development system and Monte Carlo generated shower patterns to test the chip. A C ++ application program was developed that runs within the development system but extends chip control and testing capabilities beyond the standard routines. With this program several configurations of the chip parameters were tested and the results are discussed here.

6400 (FNAL-TM–1799) **Source calibrations and SDC calorimeter requirements.** Green, D. Fermi National Accelerator Lab., Batavia, IL (United States). Oct 1992. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. Order Number DE93004712. Source: OSTI; NTIS; INIS; GPO Dep.

Several studies of the problem of calibration of the SDC calorimeter exist. In this note the attempt is made to give a connected account of the requirements on the source calibration from the point of view of the desired, and acceptable, constant term induced in the EM resolution. It is assumed that a "local" calibration resulting from exposing each tower to a beam of electrons is not feasible. It is further assumed that an "in situ" calibration is either not yet performed, or is unavailable due to tracking alignment problems or high luminosity operation rendering tracking inoperative. Therefore, the assumptions used are rather conservative. In this scenario, each scintillator plate of each tower is exposed to a moving radioactive source. That reading is used to "mask" an optical "cookie" in a grey code chosen so as to make the response uniform. The source is assumed to be the sole calibration of the tower. Therefore, the phrase "global" calibration of towers by movable radioactive sources is adopted.

6401 (FNAL-TM–1810) **The effects of cracks on calorimeter response in the SDC "dogleg" design.** Green, D. Fermi National Accelerator Lab., Batavia, IL (United States). Nov 1992. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. Order Number DE93004388. Source: OSTI; NTIS; INIS; GPO Dep.

In an initial attempt to set the scale for cracks, the reaction $H(800) \rightarrow ZZ \rightarrow (q + q) \rightarrow (\tau l + \tau 2) \rightarrow (\rho l + \nu i) + (\rho 2 + \nu 2)$ was studied. The figure of merit was taken to be the Z transverse mass, i.e. the mass of $(\rho 1 + 2 + E_T)$. With no cracks in the coverage save the beam holes at $\eta = 5$, this quantity has a fractional spread of $\sim$ 12%. The additional contribution of cracks was unfolded in quadrature. Clearly, the scale where the effects of cracks becomes important for this physics process is a few cm (few % of azimuth). At a full crack width of 4 cm, the additional contribution due to cracks is comparable to all the other effects intrinsic to the decay kinematics and to the SDC baseline detector. Note that these cracks are "complete", in that it is assumed that all energy incident on them is completely lost Since the barrel wedge in SDC will have an irreducible dead space of width, $\sim$ 1 cm due to fiber routing, light tightening, etc., it was decided to study a "dogleg" geometry.

6402 (GSI–92-07) **Search for impurities of counting gases in ionization chambers.** Hofmann, T. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany); Frankfurt Univ. (Germany). Inst. fuer Kernphysik. Mar 1992. 92p. (In German). Order Number DE93742846. Source: OSTI; NTIS (US Sales Only); INIS.

In order to reach for the gas detectors applied at the ALADIN spectrometer of the GSI an as good as possible and timely remaining gas purity, a study on the kind and effects of impurities in different counting gases was performed. The gas purity was observed via the signal height of an α source after a drift path of the electrons of 50 cm. A steady decrease of the α-signals was measures, the steepness of which decreases slowly as function of the time. The half-life lies in the range of weeks, which lets conclude on a slow outgassing from the materials of the arrangement. By a gas chromatography and mass spectroscopy these impurities could be determined. Beside impurities by polar molecules as water and

oxygen from the atmosphere, which are deposed in microscopical capillaries of the chamber materials and then outgassed in the samples after several days so-called softeners could be observed. Because these impurities in the arrangement at the ALADIN spectrometer cannot be avoided, a purification system in the flow-through operation was constructed and its effect tested. The gas quality can by this over several days be kept in the mean constant. In this dynamical process the fluctuations of the signal heights lie at ±0.7%. A ionization chamber as monitor for the gas purity was constructed and tested with different gas mixtures concerning observables like signal height and drift time. By this calibrated monitor in the experiment at the ALADIN spectrometer the gas quality can be independently determined. (orig.).

6403 (GSI–92-12) **Development of a fragment detector system for the study of peripheral collisions at high beam energies.** Spies, H. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany); Frankfurt Univ. (Germany). Fachbereich 13 - Physik. Jun 1992. 129p. (In German). Order Number DE93744613. Source: OSTI; NTIS (US Sales Only); INIS.

In the framework of the experimental program at the accelerator facilities SIS/ESR of the Society for Heavy-Ion research in Darmstadt one of the essential research aims of the LAND collaboration is the study of high-lying collective states after electromagnetic excitation in heavy-ion collisions at nearly relativistic beam energies. By the exchange of virtual photons with high energy giant resonances are excited with high probabilities. The main decay channel of giant resonances in heavy nuclei is the emission of neutrons as well as below the particle threshold the emission of γ radiation. For the study of these states a detector system was developed, which makes the kinematically complete measurement of all reaction partners possible. For the determination of the neutron energy serves the Large Area Neutron Detector LAND, a time-of-flight spectrometer for high-energetic neutrons. For the measurement of the γ radiation emitted by the excited projectile the target is surrounded by an array of 48 BaF_2 crystals. A radiation detector system consisting of 6 single detectors and further 5 help detectors allows together with the magnetic spectrometer ALADIN the identification of the heavy projectile fragments by charge, momentum, and mass. Four position-sensitive plastic scintillators serve for the measurement of the trajectory of the projectile respectively the projectile fragments in front and behind the deviating magnet. Additionally with these detectors the velocity is measured. For the determination of the nuclear charge of the projectile fragments serve a multiple-ionization chamber and a Cherenkov detector. In this thesis the development and taking into operation of the LAND radiation detector system is described. (orig./HSI).

6404 (IAEA-R–6687-F) **Verification of absorbed doses determined with thimble and plane-parallel ionization chambers in clinical electron beams using ferrous sulphate dosimetry: Final report for the period 1 July 1991 - 1 July 1992.** Thierens, H. (Ghent Univ., Ghent (Belgium). Standard Dosimetry Lab.). International Atomic Energy Agency, Vienna (Austria). Sep 1992. [26] Order Number DE93609494. Source: OSTI; NTIS (US Sales Only); INIS.

Different ionometric methods to determine absorbed dose in phantoms irradiated with electron beams were tested using ferrous sulphate dosimetry as a reference method. Irradiation was carried out with three different types of accelerators in the energy range 4 to 20 MeV. Three different types of plane parallel ionization chambers were used and two types of cylindrical chambers. It was found that the ionization chamber dosimetry following the International Code of Practice (TRS 277) gave dose values as a mean 0.6% higher than the ferrous sulphate dosimetry based on the ICRU report 35. There were no significant differences between results measured at different electron energies. The mean deviation obtained using the two dosimeter systems is inside the experimental uncertainty. This proves that the TRS 277 can be used for accurate dosimetry. Further, the results show that corrections are needed for some types of plane parallel plate chambers to correct for the perturbation by the chamber of the electron fluence in the water phantom, and that values of these corrections are given as a function of the electron energy. 14 refs, 4 figs, 2 tabs.

6405 (IEN–30/91) **Calibration of an albedo dosemeter at CV-28 cyclotron.** Fajardo, P.W. (Instituto de Engenharia Nuclear (IEN), Rio de Janeiro, RJ (Brazil)); Mauricio, C.L.P. Instituto de Engenharia Nuclear (IEN), Rio de Janeiro, RJ (Brazil). Nov 1991. [17] (In Portuguese). Order Number DE93609495. Source: OSTI; NTIS (US Sales Only); INIS.

This work deals with the analysis and application of neutron measurement techniques in order to obtain information on the neutron spectrum and neutron dose equivalent at several representative working places of the cyclotron laboratory of the Instituto de Engenharia Nuclear at Rio de Janeiro, Brazil. Bonner spheres and foil activation were used for the neutron spectra measurements and the neutron dose equivalents were measured with the single sphere albedo technique from the Kernforschungszentrum Karlsruhe, B F_3 and ^{3} He proportional detectors and ^{6} Li I scintillation detector. The brazilian albedo dosemeter was calibrated with the single sphere albedo technique. Calibration factors were found for routine applications, when the workers are protected by the shieldings and for radiological accident application, in case a worker is exposed inside the irradiation rooms. (author).

6406 (IEN–37/92) **A comparative study about the efficiency of several industrial radiographic intensifying screens types by evaluation factor and the equivalent penetrometer sensitivity.** Ramos, C.W.; Gante, V.; Ribeiro, L.M. Instituto de Engenharia Nuclear (IEN), Rio de Janeiro, RJ (Brazil). May 1992. [26] (In Portuguese). Order Number DE93609515. Source: OSTI; NTIS (US Sales Only); INIS.

When a x-ray or gamma-ray beam strikes a film usually less than 1% of the energy is absorbed resulting in a photographic effect. Obviously, any mean of utilizing more fully the unabsorbed percentage of energy without complicating too much the technical radiographic procedure is highly desirable. One very common procedure is to use the film between two intensifying screens. These screens have the property of emitting electrons (lead screens) or become fluorescent (fluorescent screens) when stricken by electromagnetic radiation thus resulting in a supplementary photographic action on the film emulsion. This work presents an efficiency comparison of the more usual varieties of these intensifying screens for energies of x-ray until 300 K V. (author).

6407 (INIS-BR–2942, pp. 30-31) **Design and construction of a electrochemical attack chamber.** Souza, M.I.S. (Instituto de Engenharia Nuclear (IEN), Rio de Janeiro, RJ (Brazil). Div. de Fisica de Reatores). Instituto de Engenharia Nuclear (IEN), Rio de Janeiro, RJ (Brazil). Dept. de Reatores. 1989. 147p. (In Portuguese). In *Triennial technical report - 1986, 1987, 1988 - Instituto de Engenharia Nuclear (IEN) -Dept. of Reactors (DERE).* Order Number DE93605069. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. FISSION TRACKS/electrochemistry; ELECTRODES; ELECTROCHEMISTRY; ORGANIC POLYMERS; PLATINUM; SPECIFICATIONS

6408 (INIS-BR–3061) **Development of instrumentation in nuclear geophysics and their use in Morro do Ferro.** Hiodo, F.Y. Sao Paulo Univ., SP (Brazil). Inst. Astronomico e Geofisico. 1989[192] (In Portuguese). Order Number DE93609516. Source: OSTI; NTIS (US Sales Only); INIS.

The development of nuclear detection and stabilization circuits was described. Furthermore, gamma and alpha spectrometry methodologies were developed for field and laboratory measurements. By the use of techniques from other geophysical instruments as fluxgate and optical pumping magnetometers, it was possible to develop stabilization and linearization circuits for gamma ray spectrometers composed by scintillation crystals and multichannel analyzers. The developed system presents excellent thermal and temporal stability, leading to a high reproducibility of the measurements. Teflon PTFE electrets based ionization chambers were constructed for monitoring the alpha particles from soil emanated radon, from the uranium and thorium radioactive series. (author).

6409 (INS–939) **Development of microstrip gas chamber and application to imaging gamma-ray detector.** Tanimori, T. (Tokyo Inst. of Tech. (Japan). Dept. of Physics); Minami, S.; Nagae, T.; Takahashi, T.; Miyagi, T. Tokyo Univ., Tanashi (Japan).

Inst. for Nuclear Study. Jul 1992. 11p. Order Number DE93754294. Source: OSTI; NTIS; INIS.

We have developed Microstrip Gas Chamber (MSGC) by using Multi-Chip technology which enables high-density assembly of bare LSI chips on a silicon board. Our MSGC was operated steadily with $\approx 10^3$ gain more than one week. An energy resolution of 15% (FWHM) for 5.9 keV X-ray of ^{55}Fe was obtained. With very thin polyimide substrate of 16 μm thickness, two interesting phenomena were observed; one is a strong dependence of gains on the back plane potential, and the other is little time variation of gains. New type of MSGC with a guarding mask of a thin polyimide layer on the cathode edges has been examined to reduce incidental electrical discharges between anode and cathode strips. Furthermore, new approach to reduce the resistivity of the substrate has been examined. By these approaches, the stability of the high gain operation of $\approx 10^4$ has been drastically improved. In addition, we discuss the possibility of the application of MSGC to the coded mask X-ray imaging detector for astrophysics. (author).

6410 (JINR–7-46-90, pp. 58-63) **VME multiprocessor system for data analysis.** Senner, A.E. (Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of High Energy); Smirnov, V.A.; Trofimov, V.V. Joint Inst. for Nuclear Research, Dubna (Russian Federation). 1990. (In Russian). In *JINR rapid communications: Collection.* [77] Order Number DE93609511. Source: OSTI; NTIS (US Sales Only); INIS.

A multiprocessor system for a parallel analysis of data from elementary particle physics experiments is constructed. It includes one host and three peripheral processors, which are VME 32-bit CPU-boards based on MC68020 microprocessors. The VERSADOS oriented software for task preparation and task execution is realized. A working test of the computing multiprocessor system is performed by means of a task that simulates experimental data analysis in high energy physics. This task shows the possibility and performance of data parallel analysis on this system. 2 refs.; 2 figs.

6411 (JINR–7-46-90, pp. 75-77) **Drift chambers for precision track measurement of the trajectories of high energy muons.** Barabash, L.S. (Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Nuclear Problems); Kazarinov, M.Yu. Joint Inst. for Nuclear Research, Dubna (Russian Federation). 1990. In *JINR rapid communications: Collection.* [77] Order Number DE93609511. Source: OSTI; NTIS (US Sales Only); INIS.

The possibilities of increasing the registration precision of drift chambers are discussed, the conditions of space effects suppression with the help of a summation scheme are considered, a scheme of the muon spectrometer with a ϕ-magnetic field for neutrino detector is proposed.

6412 (JINR-E–8-91-67) **SQUIDs in thermal detectors of weakly interacting particles.** Trofimov, V.N. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Nuclear Problems. 1991. [14] Order Number DE93609531. Source: OSTI; NTIS (US Sales Only); INIS.

The application of four different types of SQUID-assisted thermometers for cryogenic thermal detectors of weakly interacting particles is analyzed with two of them for the first time. The classic resistive thermometer is considered as well for the comparison. Original results of testing the detector with working temperature of 1K and thermocouple thermometer with SQUID are given. The conclusion is made that temperature resolution of 10^{-10} kHz$^{-1/2}$ or energy sensitivity of 1-10 eV per 1 kg of detector mass can be achieved when using the SQUID-assisted thermometers. 12 refs.; 7 figs.; 1 tab.

6413 (JINR-R–1-91-30) **The setup calculation for the B-meson registration at 400 GeV and 3 TeV.** Morozova, Eh.Ya.; Sviridov, V.A.; Takhtamyshev, G.G. Joint Inst. for Nuclear Research, Dubna (Russian Federation). 1991. [12] (In Russian). Order Number DE93609508. Source: OSTI; NTIS (US Sales Only); INIS.

Some calculation of the setup for B-meson investigation was performed using the Monte Carlo simulation method. The B-meson event generation has been accomplished by the implementation of the PYTHIA-generator from the Lund suite of event generation programs. Acceptance, the reconstruction coordinate vertex accuracy, decay particle momentum measurements and other features of B-meson decay products are presented. 3 refs.; 21 figs.

6414 (JINR-R–1-91-110) **Reconstruction of tracks detected in setup ARES (X-Y plane).** Kisel', I.V.; Konotopskaya, E.V.; Korenchenko, S.M.; Kravchuk, N.P. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Nuclear Problems. 1991. [12] (In Russian). Order Number DE93609507. Source: OSTI; NTIS (US Sales Only); INIS.

Crawford and conformal mapping for the track reconstruction in X-Y plane are compared. The realization of the conformal mapping method for the ARES magnetic spectrometer is described. The experimental data obtained in the experiment on the search for the decay $\mu \rightarrow 3e$ are used to test this method. 9 refs.; 5 figs.; 3 tabs.

6415 (JINR-R–10-91-81) **Interaction of user with ES computers controlled by VM operating system in the course of mathematical processing of film information.** Buzdavina, N.A.; Ehrdehnehdehlgehr, T. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Computing Techniques and Automation. 1991. [8] (In Russian). Order Number DE93609500. Source: OSTI; NTIS (US Sales Only); INIS.

A user-friendly program interface is considered which provides convenience and psychological comfort in the course of mathematical processing of the film information. The interface is designed for ES computers controlled by the VM operating system. 8 refs.; 2 figs.

6416 (JINR-R–10-91-86) **Creating and editing of the chamber photograph scanning file in the interactive mode.** Shokirov, I.Eh. (AN Uzbekskoj SSR, Tashkent (Uzbekistan). Inst. Yadernoj Fiziki); Ehrdehnehdehlgehr, T. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Computing Techniques and Automation. 1991. [10] (In Russian). Order Number DE93609509. Source: OSTI; NTIS (US Sales Only); INIS.

Software subsystem for creating and editing of the chamber photograhp scanning file in the interactive mode are considered. It is intended for ES computers controlled by the SVM operating system and IBM PC/XT computer. The software system is used in studies on nucleon-nucleon interactions. 8 refs.; 4 figs.

6417 (JINR-R–13-90-527) **The experimental setup POSITRONIUM and its precision characteristics.** Afanas'ev, L.G. (and others); Karpukhin, V.V.; Komarov, V.I. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Nuclear Problems. 1990. [22] (In Russian). Order Number DE93609510. Source: OSTI; NTIS (US Sales Only); INIS.

The described setup has been used for investigation of processes with ultrarelativistic positronium atoms and effect of Coulomb interaction of $\pi^+\pi^-$ in a final state. The setup consists of a high vacuum channel, magnetic spectrometer and detectors for identification of electrons, muons and hadrons. For particle generation the targets 0.5-10 μm thick, which were inserted into the internal proton beam of the IHEP proton synchrotron, were used. A high resolution has been obtained for the relative momentum of a pair due to using thick target excluding matter between the target and the spectrometer, measuring a pair opening angle on the base of 40 m. 22 refs.; 8 figs.

6418 (JINR-R–13-91-34) **Data acquisition system in experiments on VASILISA setup.** Andreev, A.N.; Gorshkov, V.A.; Bogdanov, D.D.; Eremin, A.V.; Kabachenko, A.P.; Kuznetsov, A.N.; Ter-Akop'yan, G.M.; Chepigin, V.I. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Nuclear Reactions. 1991. [14] (In Russian). Order Number DE93609502. Source: OSTI; NTIS (US Sales Only); INIS.

Multidetector data acquisition system used in experiments on the VASILISA separator, is presented. The detecting module consisting of two time-of-flight detectors and eight semiconductor planar detectors, is described. Electronic circuit designed on the base of CAMAC units and IBM PC/AT computer, is given. 8 refs.; 9 figs.

6419 (JINR-R–13-91-134) **The investigation of the performances of semiconductor microstrip detectors.** Amelin, A.I. (Moskovskij Inzhenerno-Fizicheskij Inst., Moscow (Russian Federation)); Besfamil'nov, S.V.; Gornov, M.G. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Nuclear Problems.

1991. [18] (In Russian). Order Number DE93609501. Source: OSTI; NTIS (US Sales Only); INIS.

The performances of microstrip detectors manufactured by TESLA are presented. The detectors are operated in slightly underdepleted mode and resistive charge partition between adjacent strips is investigated. Spatial and energy characteristics received permit to conclude about the possibility of using such detectors in the low and middle energy region. 6 refs.; 13 figs.

6420 (KEK–92-1) **Conceptual design report for the SDC barrel and intermediate muon detectors based on a jet-type drift chamber.** Arai, Y. (and others); Funahashi, Y.; Higashi, Y. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Apr 1992. 241p. Order Number DE93753173. Source: OSTI; NTIS; INIS.

We propose a jet-type drift chamber for the barrel and intermediate muon detectors of SDC. The chamber system consists of large multiwire drift chambers having a simple box-type frame structure: 2. 5 x 0.4 m^2 in cross section and maximum 9 m in length. A chamber module consists of double layers of small jet cells. The drift cell is composed of a wire plane, including 3 sense wires, and cathode plates parallel to the wire plane. The two layers in a chamber are staggered to each other by half a cell width. The jet cell is tilted such that its principle axis points to the interaction point. Such an arrangement, together with a constant drift velocity of the jet cell, allows us to design a simple and powerful trigger system for high momentum muons utilizing a drift time sum between a pair of staggered cells. The multi-hit capability will be helpful to distinguish high momentum muon tracks from associated electromagnetic debris as has been demonstrated by the Fermilab beam test T816. The maximum drift time fulfills the SDC requirement. A preliminary FEM analysis of the chamber module verified the excellent structural stiffness. It makes the support structure and the alignment system relatively simple. These features will reduce the total cost as well as ensure a good performance of the chamber system. (J.P.N.).

6421 (KEK-PROC–92-8) **Proceedings of the third workshop on light quark meson spectroscopy.** Takamatsu, Kunio; Tsuru, Tsuneaki (eds.). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Sep 1992. 226p. (CONF-9202147–: 3. workshop on light quark meson spectroscopy, Tsukuba (Japan), 28-29 Feb 1992). Order Number DE93754138. Source: OSTI; NTIS; INIS.

This issue is the collection of the papers presented at the title meeting. The 18 of the presented papers are indexed individually. (J.P.N.).

6422 (KFTI–90-10) **Study on the electron-photon shower energy release profiles.** Ambrosimov, V.K.; Danilov, N.A.; Livadnyj, E.A.; Maslov, N.I.; Pugachev, G.D. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. [9] (In Russian). Order Number DE93609496. Source: OSTI; NTIS (US Sales Only); INIS.

Calculations and experimental studies of energy release profiles in multilayer structures of alternating organic glass, aluminium and lead layers in 0.5-1.2 GeV electron accelerator are carried out using film badges (FB). 5 refs.; 7 figs.

6423 (LA–12390-MS) **Experimental evaluation of software-driven digital gain-drift compensation in scintillator gamma-ray spectroscopy.** Russo, P.A.; Wenz, P.A.; Painter, J.A. Los Alamos National Lab., NM (United States). Sep 1992. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93002623. Source: OSTI; NTIS; GPO Dep.

Analog and digital methods for gain stabilization and gain-drift compensation in scintillator gamma-ray spectroscopy are discussed and compared. A digital method that uses gamma-ray reference sources (instead of alpha-particle reference sources embedded as seeds within the scintillators) and software (instead of hardware) for detecting and compensating for gain drifts can be applied to any scintillator spectrometer, including those with crystals that are too small to seed. Its applications extend to other types of gamma-ray detectors as well. The results of an experimental evaluation of this method, using a compact NaI(Tl) detector and gamma-ray spectra for plutonium of variable burnup, are presented. Reliable performance was demonstrated with changing total count rate, varying continuum background and changing gain. Applications for the method are discussed.

6424 (LA–12391) **Comparison of first-principles MCNP calculations of NaI and BGO detector response functions to measurements.** Estes, G.P. (Los Alamos National Lab., NM (United States)); Schrandt, R.G.; Kriese, J.T. Los Alamos National Lab., NM (United States). Sep 1992. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93002716. Source: OSTI; NTIS; INIS; GPO Dep.

First-principles NaI and BGO detector response functions calculations made with the MCNP code are compared to measurements. Excellent agreement is achieved for the experiments analyzed. Such calculational methodology can be used to achieve a better understanding of the physics of detector response and to maximize the information content available from measured data.

6425 (LA-UR–92-3223) **Radiation calculations using LAHET/MCNP/CINDER90.** Waters, L. Los Alamos National Lab., NM (United States). [1992]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9209263–5: 3. international conference on calorimetry in high energy physics, Corpus Christi, TX (United States), 29 Sep - 2 oct 1992). Order Number DE93003696. Source: OSTI; NTIS; INIS; GPO Dep.

The LAHET Code System is now being used to address a variety of topics in radiation calculations needed by high energy physics. Recent improvements to the code are described, and two example calculations are presented. The first illustrated the use of the code in simulating low energy neutron response for the lead scintillator sampling calorimeter of Brookhaven experiment 814. The second describes the neutron fluence and activation calculations done for the forward calorimeter in the proposed SSC GEM detector.

6426 (LA-UR–92-3330) **Photon energy response of an aluminum oxide TLD environmental dosimeter.** Olsher, R.H. Los Alamos National Lab., NM (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-921005–7: Nuclear science symposium, Orlando, FL (United States), 26-31 Oct 1992). Order Number DE93003738. Source: OSTI; NTIS; INIS; GPO Dep.

Because of aluminum oxide's significant advantage in sensitivity (about a factor of 30) over LiF, minimal fading characteristics and ease of processing, aluminum oxide thermoluminescent dosimeters (TLDS) are being phased in at Los alamos for environmental monitoring of photon radiation. The new environmental dosimeter design consists of a polyethylene holder, about 0. 5 cm thick, loaded with a stack of four aluminum oxide TLD chips, each 1 mm thick and 5 mm in diameter. As part of the initial evaluation of the new design, the photon energy response of the dosimeter was calculated over the range from 10 keV to 1 MeV. Specific goals of the analysis included the determination of individual chip response in the stack, assessment of the response variation due to TLD material (i.e., LiF versus $Al_2 O_3$), and the effect of copper filtration in flattening the response.

6427 (LA-UR–92-3541) **The temporal response and relative proton-to-gamma ratio of radiation detectors made from natural diamond.** Wagner, R.S. (Los Alamos National Lab., NM (United States)); Hilko, R.A.; Harper, R.W.; Tinsley, J.R. Los Alamos National Lab., NM (United States). [1992]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-921005–10: Nuclear science symposium, Orlando, FL (United States), 26-31 Oct 1992). Order Number DE93003791. Source: OSTI; NTIS; GPO Dep.

Measurements have been made on photoconductive detectors made from natural Class IIa diamond and from neutron-irradiated GaAs using identical physical geometries. The temporal response, relative proton-to-gamma ratio, and relative sensitivity were measured. For comparison, the same measurements were made on similarly configured InP(Fe) detectors. The temporal response of the diamond detectors varied from 145 to 360 ps full width at half maximum (FWHM) for a 30 ps, 16 MeV end point bremsstrahlung pulse. This compares to 103 ps FWHM for the GaAs detectors. Proton-to-gamma ratios for the diamond detectors were > 3.5 times

those of the reference GaAs detector. The ratio was 1.2 times the reference for InP(Fe) detectors. The relative sensitivities of the diamond detectors, compared with the GaAs detectors, was 0.5 to 0.7. The leakage current of the diamond detectors was at least three orders of magnitude lower than the GaAs devices. Finally, the temporal response of nuetron-irradiated diamond detectors was 90 ps FWHM, a significant improvement in speed over natural diamond.

6428 (LA-UR–92-3601) **Custom bipolar integrated circuit designs for the front-end electronics of the Silicon Tracker subsystem for SSC-GEM Detector.** Hahn, S.F.; Cafferty, M.M. Los Alamos National Lab., NM (United States). [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9210232–1: Institute Electrical and Electronic Engineers (IEEE) meeting, Orlando, FL (United States), 26-30 Oct 1992). Order Number DE93003803. Source: OSTI; NTIS; GPO Dep.

Extremely high radiation background (up to 5 MRad over a 10 year lifetime), a large number of channels (3.2 M), high speed, low noise requirements (1250 electrons RMS), and low power consumption (1 mW/channel), present a formidable challenge for front-end electronics for the Silicon Tracker subsystem for the GEM (Gamma, Electron, Muon) Detector of the Superconducting Super Collider Project. The design requirements and preliminary results from the bipolar designs for an analog integrated circuit are presented. The analog processing chain includes a preamplifier, an amplifier/shaper/baseline restorer combination, and a level discriminator with a logic output.

6429 (LA-UR–92-3602) **A semi-custom multi-channel preamplifier integrated circuit for nuclear instrumentation.** Fuller, K.R. Los Alamos National Lab., NM (United States). [1992]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9210232–2: Institute Electrical and Electronic Engineers (IEEE) meeting, Orlando, FL (United States), 26-30 Oct 1992). Order Number DE93003802. Source: OSTI; NTIS; GPO Dep.

A monolithic eight-channel preamplifter for spaceborne nuclear instrumentation is being developed using a semi-custom Application Specific Integrated Circuit (ASIC) based on bipolar tile-array technology, This general purpose charge sensitive preamplifier was designed using a complimentary current mirror approach so that it would be useful for amplifying both positive-going and negative-going input pulses while consuming low to moderate power. The input stages employ a common-collector/common-base topology for good bandwidth and slew characteristics. The output stages employ power devices configured as class AB and are capable of driving 50-ohm loads. Each of the eight channels can be biased or enabled separately. The design is implemented with dielectrically isolated, vertical geometry transistors. Such devices are inherently radiation-hard and have PNP transistors whose performance is superior to the lateral geometry types. This paper describes a unique aspect of the design and computer simulation results of the ASIC.

6430 (LA-UR–92-3603) **A semi-custom dual channel peak hold circuit for spaceborne instrumentation.** Sweet, M.R.; Grace, K.M. Los Alamos National Lab., NM (United States). [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9210232–3: Institute Electrical and Electronic Engineers (IEEE) meeting, Orlando, FL (United States), 26-30 Oct 1992). Order Number DE93003801. Source: OSTI; NTIS; GPO Dep.

A monolithic dual channel peak hold circuit is developed using a semi-custom Application Specific Integrated Circuit (ASIC). The circuit is designed specifically for spaceborne instrumentation that requires low power operation and low mass packaging. Each independent circuit holds positive pulses and consists of a differential transconductance amplifier followed by a one way current amplifier. Input gate and output hold functions are enabled by standard TTL or CMOS logic levels. To accommodate a range of applications. quiescent power is adjustable for performance-power tradeoff or can be disabled for single channel use. Fabricated with dielectrically isolated vertical geometry NPN and PNP transistors the circuit is inherently radiation-hard and immune to transient upset.

6431 (LA-UR–92-3646) **Error bounds for MEG and EEG source localization.** Mosher, J.C. (University of Southern California, Los Angeles, CA (United States). Signal and Image Processing Inst.); Spencer, M.E.; Leahy, R.M. Los Alamos National Lab., NM (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9210231–2: 26. annual Asilomar conference on signals, systems, and computers, Pacific Grove, CA (United States), 25-30 Oct 1992). Order Number DE93003794. Source: OSTI; NTIS; GPO Dep.

Localization error bounds are presented for both EEG and MEG as graphical error contours for a 37 sensor arrangement. Both one and two dipole cases were examined for all possible dipole orientations and locations within a head quadrant. The results show a strong dependence on absolute dipole location and orientation. The results also show that fusion of the EEG and MEG measurements into a combined model reduces the lower bound. A Monte-Carlo simulation was performed to check the tightness of the bounds for a selected case. The simple head model, the white and relatively low power noise, and the few relatively strong dipoles were all selected in this study as optimistic conditions to establish possibly fundamental resolution limits for any localization effort.

6432 (SLAC-PUB–5925) **Preliminary test results from a telescope of Hughes pixel arrays at FNAL.** Jernigan, J.G. (California Univ., Berkeley, CA (United States). Space Sciences Lab.); Arens, J.; Vezie, D.; Shapiro, S.L.; Collins, T.; Krider, J.; Skubic, P. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Sep 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-9204126–16: B factories: state of the art in accelerators, detectors, and physics, Stanford, CA (United States), 6-10 Apr 1992). Order Number DE93004007. Source: OSTI; NTIS; INIS; GPO Dep.

In December of 1991 three silicon hybrid pixel detectors each having 2.56 x 2.56 pixels 30 μm square, made by the Hughes Aircraft Company, were placed in a high energy muon beam at the Fermi National Accelerator Laboratory. Straight tracks were recorded in these detectors at angles to the normal to the plane of the silicon ranging from 0 to 45°. In this note, preliminary results are presented on the straight through tracks, i.e., those passing through the telescope at normal incidence. Pulse height data, signal-to-noise data, and preliminary straight line fits to the data resulting in residual distributions are presented. Preliminary calculations show spatial resolution of less than 5 μm in two dimensions.

6433 (SLAC-PUB–5945) **The first results from the CRID detector at SLD.** Va'vra, J. (Stanford Linear Accelerator Center, Menlo Park, CA (United States)); Antilogus, P.; Aston, D.; Bienz, T.; Bird, F.; Dasu, S.; Dolinsky, S.; Dunwoodie, W.; hallewell, G.; Kawahara, H.; Kwon, Y.; Leith, D.W.G.S.; Mueller, G.; Muller, D.; NagamineStanford Linear Accelerator Center, Menlo Park, CA (United States). Oct 1992. 7p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract AC03-76SF00515 ;AT03-76ER70023. Grants: PHY88-13669;PHY91-13428;PHY92-04239. (CONF-920837–12: ICHEP-26: 26th International Union of Pure and Applied Physics (IUPAP) conference on high energy physics, Dallas, TX (United States), 6-12 Aug 1992). Order Number DE93004014. Source: OSTI; NTIS; INIS; GPO; GPO Dep.

We report first results from the initial physics run of the Cherenkov Ring Imaging Detector (CRID) in the SLD experiment at the SLC. We describe the experimental conditions, show liquid and gas rings, report the number of photoelectrons per ring, and comment on resolution.

6434 (SLAC-PUB–5946) **The B factory detector for PEP-II: A status report.** Ratcliff, B. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Oct 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-920837–11: ICHEP-26: 26th International Union of Pure and Applied Physics (IUPAP) conference on high energy physics, Dallas, TX (United States), 6-12 Aug 1992). Order Number DE93004015. Source: OSTI; NTIS; INIS; GPO Dep.

The performance required of a physics detector at an asymmetric e^+e^-B factory is briefly discussed. The status of the PEP-II detector and associated R&D is ten described.

6435 (SLAC-PUB–5953) **SLD liquid argon calorimeter.** Vella, E. SLD Collaboration. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Oct 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-9209263–1: 3. international conference on calorimetry in high energy physics, Corpus Christi, TX (United States), 29 Sep - 2 oct 1992). Order Number DE93004017. Source: OSTI; NTIS; INIS; GPO Dep.

The liquid argon calorimeter (LAC) of the SLD detector is a parallel plate – liquid argon sampling calorimeter, used to measure particle energies in Z^0 decays at the Stanford Linear Collider. The LAC module design is based on a unique projective tower structure, in which lead plates and segmented lead tiles serve both as absorbers and electrodes. The LAC front end electronics incorporates several novel features, including extensive multiplexing and optical fiber readout, which take advantage of the low SLC beam crossing frequency. The operational performance of the LAC during the recently completed SLD physics run (which recorded over 10,000 Z^0 events) is discussed.

6436 (SSCL-Preprint–164) **3D-Flow processor for a calorimeter programmable Level-1 trigger.** Crosetto, D. Superconducting Super Collider Lab., Dallas, TX (United States). Oct 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-921005–2: Nuclear science symposium, Orlando, FL (United States), 26-31 Oct 1992). Order Number DE93002778. Source: OSTI; NTIS; INIS; GPO Dep.

The types of detectors and the physics involved in present experiments are reaching a level of cost and complexity so great that it is preferable to implement a programmable trigger solution at all levels rather than a system realized with cabled logic. Experience demonstrates that fine tuning on the trigger is often achieved only after running an experiment and analyzing the first data acquired. A Level-1 trigger is required to identify objects (particles such as electron, jets, etc.) with programmable algorithms at 60 million frames-per-second. These requirements have led to the design of a special "3D-Flow" processor that, together with a special pipelined parallel-processing architecture, allows a sustained data rate of 60 million frames-per-second. The 3D-Flow is a data-flow processor that can be used in one-, two-, or three-dimension array for high-speed signal-processing applications such as identifying objects in a matrix in a programmable form. Feasibility studies demonstrate that with present technology a 3D-Flow chip consuming 8 W, and accommodating 32 processors at 60 MHz can be built today, and that the same chip can be built one year from now at a 120-MHz clock rate.

6437 (STUK-A–101) **Improved processes in therapy dosimetry with solid LiF thermoluminescent detectors.** Toivonen, M. Finnish Centre for Radiation and Nuclear Safety (STUK), Helsinki (Finland). Aug 1991. [72] Order Number DE93609497. Source: OSTI; NTIS; INIS.

The thesis also includes six previosly published articles.

The thesis presents criteria for thermoluminescence dosimetry systems suitable for precision measurements and, moreover, a detailed examination of the sources of systematic and random error. Instructions are given for annealing processes, calibration procedures, quality control, and operational rules, which are necessary in modern TLD. The performances of some principally different systems are compared. The old LiF-powder-based TLD system, with an overall uncertainty of measurement of about 1.6 percent for ten repeated readouts and for irradiations under calibration conditions with Co-60, is still the best but a comparable, although slightly lower, accuracy of about 1.7 percent can be reached more conveniently with solid LiF detectors. In measurements where absolute system calibration is not of interest (i.e., in depth-dose curve measurements, etc.), the advantages of the simple powder-based system are even more concrete. An integrated TLD process is presented for progressive utilization of automation in precision measurements. The sources of random error and unknown systematic error in current readout instruments are examined. Mechanical tolerances in critical parts of the readout instruments are thought to be the reason why the method of heating with hot gas has not been superior with respect to the precision of measurements, in spite of the excellent repeatability of the glow curve shape observed for successive readouts.

6438 (UM-P–91/44) **A self-aligning interferometer suitable for white or monochromatic light consisting solely of a mirror and a reflection grating. Part II: Experimental results.** Wark, S.J.; Opat, G.I. Melbourne Univ., Parkville, VIC (Australia). School of Physics. [1991]. [27] Sponsored by Australian Research Council, Canberra, ACT (Australia). Order Number DE93609517. Source: OSTI; NTIS (US Sales Only); INIS.

Theoretical aspects published as Part I in J. Mod. Opt. v.34 p. 1375-1384.

The performance of the self-aligning interferometer constructed solely from a mirror and reflection grating is experimentally investigated herein. The observations show good agreement with calculations using both the exact optical theory, and agreement at the level expected with the leading order terms in a convenient approximation. 2 refs., 13 figs.

4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

Refer also to citation(s) 6425

6439 (CONF-920716–9) **Fast neutron-induced changes in net impurity concentration of high-resistivity silicon.** Tsveybak, I. (Tennessee Univ., Knoxville, TN (United States)); Bugg, W.; Harvey, J.A.; Walter, J. Oak Ridge National Lab., TN (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400 ;FG05-91ER40627. From Nuclear and space radiation effects conference; New Orleans, LA (United States); 13-17 Jul 1992. Order Number DE93003104. Source: OSTI; NTIS; INIS; GPO Dep.

Resistivity changes produced by 1 MeV neutron irradiation at room temperature have been measured in float-zone grown n and p-type silicon with initial resistivities ranging from 1.8 to 100 kΩcm. Observed changes are discussed in terms of net electrically active impurity concentration. A model is presented which postulates escape of Si self-interstitials and vacancies from damage clusters and their subsequent interaction with impurities and other preexisting defects in the lattice. These interactions lead to transfer of B and P from electrically active substitutional configurations into electrically inactive positions (B_i, P_i, and E-center), resulting in changes of net electrically active impurity concentration. The changes in spatial distribution of resistivity are discussed, and the experimental data are fit by theoretical curves. Differences in the behavior of n-type and p-type material are explained on the basis of a faster removal of substitutional P and a more nonuniform spatial distribution of the original P concentration.

6440 (CONF-921005–6) **Effects of radiation on scintillating fiber performance.** Bauer, M.L. (Oak Ridge National Lab., TN (United States)); Cohn, H.; Efremenko, Yu.; Gordeev, A.; Kamyshkov, Yu.; Onopienko, D.; Savin, S.; Shmakov, K.; Tarkovsky, E.; Young, K.G.; Carey, R.; Rothman, M.; Sulak, L.; Worstell, W.; Parr, H. Oak Ridge National Lab., TN (United States). [1992]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Nuclear science symposium; Orlando, FL (United States); 26-31 Oct 1992. Order Number DE93003620. Source: OSTI; NTIS; INIS; GPO Dep.

Continued rapid improvements in formulations for scintillating fibers require the ability to parameterize and predict effects of radiation on detector performance. Experimental techniques necessary to obtain needed information and calculational procedures used in performing predications for hadron scintillating fiber calorimetry in the Superconducting Supercollider environment are described. The experimental techniques involve control of the testing environment, consideration of dose rate effects, and other factors. These calculations involve the behavior of particle showers in the detector, expected levels of radiation, and parameterization of the radiation effects. A summary of significant work is also presented.

4405 Thermal Instrumentation

6441 (LBL–32152) **Design analysis of a novel hot-electron microbolometer.** Nahum, M. (Lawrence Berkeley Lab., CA (United States)); Richards, P.L.; Mears, C.A. Lawrence Berkeley Lab., CA (United States). Aug 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-920802–32: Applied superconductivity conference, Chicago, IL (United States), 23-28 Aug 1992). Order Number DE93002542. Source: OSTI; NTIS; GPO Dep.

We propose a novel antenna coupled microbolometer which makes use of the weak coupling between electrons and phonons in a metal at low temperatures. The radiation is collected by a planar lithographed antenna and thermalized in a thin metal strip. Resulting temperature rise of the electrons is detected by a tunnel junction, where part of the metal strip forms the normal electrode. All components are deposited directly on a substrate so that arrays can be conveniently produced by conventional lithographic techniques. The active area of the bolometer is thermally decoupled by its small volume, by thermal resistance between electrons an phonons in the strip, and by reflection of quasiparticles at interface between strip and superconducting antenna. Design calculations based on a metal volume of $2 \times 6 \times 0.05\ \mu m^3$ at an operating temperature of T=100 mK give an NEP $\approx 3 \times 10^{-19}\ WHz^{\frac{-1}{2}}$, time constant $\approx 10\ -s$, and responsivity $\approx 10^9$ V/W. The calculated sensitivity is almost two orders of magnitude higher than that of the best available direct detectors of millimeter and submillimeter radiation at the same temperature.

4406 Optical Instrumentation

Refer also to citation(s) 5761, 5969, 5970, 6088, 6364, 6613

6442 (ANL/XFD/CP–76139) **Experimental demonstration of high resolution three-dimensional x-ray holography.** McNulty, I. (Argonne National Lab., IL (United States)); Trebes, J.E.; Brase, J.M.; Yorkey, T.J.; Levesque, R.; Szoke, H.; Anderson, E.H.; Jacobsen, C.; Kern, D. Argonne National Lab., IL (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38 ;W-7405-ENG-48. (CONF-920768–8: Conference on physics and engineering of advanced detectors and collection/focusing systems, San Diego, CA (United States), 19-24 Jul 1992). Order Number DE93004178. Source: OSTI; NTIS; INIS; GPO Dep.

Tomographic x-ray holography may make possible the imaging of biological objects at high resolution in three dimensions. We performed a demonstration experiment with soft x-rays to explore the feasibility of this technique. Coherent 3.2-nm undulator radiation was used to record Fourier transform holograms of a microfabricated test object from various illumination angles. The holograms were numerically reconstructed according to the principles of diffraction tomography, yielding images of the object that are well resolved in three dimensions.

6443 (CONF-8809281–3) **X-ray Fourier-transform holographic microscope.** Haddad, W.S.; Cullen, D.; Solemt, J.C.; Boyer, K.; Rhodes, C.K. MCR Technology Corp., Chicago, IL (United States). [1988]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-86ER13610. From 4. topical meeting on short wavelength coherent radiation: generation and applications; North Falmouth, MA (United States); 26-29 Sep 1988. Order Number DE93003496. Source: OSTI; NTIS; INIS; GPO Dep.

The properties of an x-ray Fourier-transform holographic instrument suitable for imaging hydrated biological samples are described.

4408 Miscellaneous Instrumentation

Refer also to citation(s) 5335, 6090, 6114, 6441, 6452, 6844, 7095

6444 (CONF-890374–4) **A hierarachical data structure representation for fusing multisensor information.** Maren, A.J. (Tennessee Univ., Tullahoma, TN (United States). Space Inst.); Pap, R.M.; Harston, C.T. Tennessee Univ., Tullahoma, TN (United States). Space Inst.; Accurate Automation Corp., Chattanooga, TN (United States). [1989]. 17p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract FG07-88ER12824. Grant EET8901748. From SPIE technical symposium on aerospace sensing; Orlando, FL (United States); 27-31 Mar 1989. Order Number DE93002958. Source: OSTI; NTIS; GPO Dep.

A major problem with MultiSensor Information Fusion (MSIF) is establishing the level of processing at which information should be fused. Current methodologies, whether based on fusion at the data element, segment/feature, or symbolic levels, are each inadequate for robust MSIF. Data-element fusion has problems with coregistration. Attempts to fuse information using the features of segmented data relies on a Presumed similarity between the segmentation characteristics of each data stream. Symbolic-level fusion requires too much advance processing (including object identification) to be useful. MSIF systems need to operate in real-time, must perform fusion using a variety of sensor types, and should be effective across a wide range of operating conditions or deployment environments. We address this problem through developing a new representation level which facilitates matching and information fusion. The Hierarchical Data Structure (HDS) representation, created using a multilayer, cooperative/competitive neural network, meets this need. The HDS is an intermediate representation between the raw or smoothed data stream and symbolic interpretation of the data. it represents the structural organization of the data. Fused HDSs will incorporate information from multiple sensors. Their knowledge-rich structure aids top-down scene interpretation via both model matching and knowledge-based region interpretation.

6445 (CONF-8903223–1) **A hierarchical structure approach to MultiSensor Information Fusion.** Maren, A.J. (Tennessee Univ., Tullahoma, TN (United States). Space Inst.); Pap, R.M.; Harston, C.T. Tennessee Univ., Tullahoma, TN (United States). Space Inst.; Accurate Automation Corp., Chattanooga, TN (United States). [1989]. 13p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract FG07-88ER12824. Grant EET8901748. From 2. sensor fusion conference; Orlando, FL (United States); 28-29 Mar 1989. Order Number DE93002956. Source: OSTI; NTIS; GPO Dep.

A major problem with image-based MultiSensor Information Fusion (MSIF) is establishing the level of processing at which information should be fused. Current methodologies, whether based on fusion at the pixel, segment/feature, or symbolic levels, are each inadequate for robust MSIF. Pixel-level fusion has problems with coregistration of the images or data. Attempts to fuse information using the features of segmented images or data relies an a presumed similarity between the segmentation characteristics of each image or data stream. Symbolic-level fusion requires too much advance processing to be useful, as we have seen in automatic target recognition tasks. Image-based MSIF systems need to operate in real-time, must perform fusion using a variety of sensor types, and should be effective across a wide range of operating conditions or deployment environments. We address this problem through developing a new representation level which facilitates matching and information fusion. The Hierarchical Scene Structure (HSS) representation, created using a multilayer, cooperative/competitive neural network, meets this need. The MSS is intermediate between a pixel-based representation and a scene interpretation representation, and represents the perceptual organization of an image. Fused HSSs will incorporate information from multiple sensors. Their knowledge-rich structure aids top-down scene interpretation via both model matching and knowledge-based region interpretation.

6446 (ETDE/JP-mf–93753763, pp. 511-531) **Low temperature measurement (temperature, pressure, flow rate and liquid level).** Iwata, A. (Kawasaki Heavy Industries, Ltd., Tokyo (Japan)). Cryogenic Association of Japan, Tokyo (Japan). [1991]. 606p. (In Japanese). In *Proceedings of the 1st-4th cryogenic engineering summer seminar (1988-1991).* Order Number DE93753763. Source: OSTI; NTIS (US Sales Only).

The present report explained the measurement of temperature, pressure, flow rate and liquid level at low temperature. As for the thermometer, there are metallic resistance temperature measuring elemental device by the dependency of electric resistance upon

the temperature and semiconductor temperature measuring elemental device. The thermocouple utilizes the Seebeck effect. Though utilizing the denpendency of crystal vibrator frequency upon the temperature, the high resolution crystal thermometer can be made wireless. The reliability under the environment of magnetic field is still on the way of development. It is advisable for the pressure measurement to put a pressure sensor in the low temperature part and output the pressure by an electric signal. There are electrostatic capacity type by utilizing the change in electrostatic capacity of plate condenser due to the pressure and strain gauge type by measuring the diaphragm deformation by a strain gauge. It is advisable for the flow rate measurement to be able to respond to the change in physical properties. Among the velocity method flowmeters, those which are simple and high in responsibility are of a differential pressure type, turbine type and ultrasonic type. Among the mass method ones, the gyro type is taken notice of. Apart from the floater type and differential pressure type among the liquid level gauges, there is an electrostatic capacity type which obtains the liquid level by putting a double tube perpendicular in the tank and measuring the electrostatic capacity between both tubes. The report also introduced the superconducting wire type which obtains the liquid level by stretching a superconducting wire between the bottom and top of tank, having a current flow in the liquid submerged superconducting partand exposed normal conducting part, and relatively equilibrate both parts in flowing current. 19 refs., 28 figs., 4 tabs.

6447 (INIS-BR–2942, pp. 60) **Design of vertical and inclined differential manometers for low pressure measurement.** Bloch, M. (Instituto de Engenharia Nuclear (IEN), Rio de Janeiro, RJ (Brazil). Dept. de Reatores); Morgado, A. Instituto de Engenharia Nuclear (IEN), Rio de Janeiro, RJ (Brazil). Dept. de Reatores. 1989. 147p. (In Portuguese). In *Triennial technical report - 1986, 1987, 1988 - Instituto de Engenharia Nuclear (IEN) -Dept. of Reactors (DERE).* Order Number DE93605069. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. PRESSURE GAGES/coolant loops; ACCURACY; ERRORS; PRESSURE MEASUREMENT

6448 (INS–919) **Development of Microstrip Gas Chambers with Multi-Chip technology.** Nagae, T.; Tanimori, T.; Kobayashi, T.; Miyagi, T. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Mar 1992. 15p. Order Number DE93753169. Source: OSTI; NTIS; INIS.

We have developed the Microstrip Gas Chamber (MSGC) by using Multi-Chiptechnology which supports high-density assembly of bare LSI chips on a silicon wafer. Our MSGC was operated steadily with $\approx 10^3$ gain more than one week. An energy resolution of 15% for 5.9 keV X-ray of ^{55}Fe source was obtained. With a very thin polyimide substrate of 16 μm thickness, two interesting phenomena were observed; one was a strong dependence of gains on back plane potential, and the other was little time variation of gains. We also found that a guard mask of a thin polyimide layer on the cathode edge reduced incidental electrical discharges between anode and cathode strips. (author).

6449 (RFP–4673) **Reference Handbook: Pressure detectors.** EG and G Rocky Flats, Inc., Golden, CO (United States). Rocky Flats Plant. 9 Nov 1990. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC34-90DP62349. Order Number DE93004212. Source: OSTI; NTIS; GPO Dep.

The purpose of this handbook is to provide Rocky Flats personnel with the information necessary to understand pressure detection. Upon completion of this handbook you should be able to do the following: Define pressure in terms of force and area. Describe the basic operating principles of the U-Tube Manometer. Demonstrate proper techniques for reading Manometers. Describe the basic operating principles of the three types of Bourdon Tubes. Explain the difference between diaphragm. and bellows-type pressure measurement devices. This handbook is designed for use by experienced Rocky Flats operators to reinforce and improve their current knowledge level, and by entry-level operators to ensure that they possess a minimum level of fundamental knowledge. Pressure Detectors is applicable to many job classifications and can be used as a reference for classroom work or for self-study. Although this reference handbook is by no means all-encompassing, you will gain enough information about this subject area to assist you in contributing to the safe operations of Rocky Flats Plant.

6450 (SAND–92-1535) **Gauge calibration using the vacuum station.** Rebarchik, F.N. Sandia National Labs., Albuquerque, NM (United States). Nov 1992. 39p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93005380. Source: OSTI; NTIS; GPO Dep.

This memorandum is a synopsis of the description and operation of the equipment used and the events accuring during the calibration of gauges on the vacuum station over the range of 0.0001 to 650 torr.

6451 (UCRL-JC–108962) **Microphotography of shocks in crystals.** Frank, A.M. Lawrence Livermore National Lab., CA (United States). 20 Aug 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9209188–6: 20. international congress on high speed photography and photonics, Victoria (Canada), 25-26 Sep 1992). Order Number DE93002888. Source: OSTI; NTIS; GPO Dep.

Recent advances in high-speed photographic capabilities of Micro Detonics Facility (μDF) and miniature electric gun drivers have allowed real-time stop motion examination of shock waves passing through single crystals. Examination of defects and growth of dislocations from >5 GPa shocks, requires temporal resolutions of a nanosecond or better and spatial resolutions better than 10 μm. As the defects and dislocations are highly inhomogeneous, simultaneous frame and streak records of the same location within the crystal are also required. Cameras and laser illuminators, discussed previously, have been upgraded and combined into a coaxial streak and frame system. Both laser beams are tailored and aimed separately. The dye laser is spatially: filtered and focused to cover the frame. The argon laser is focused to a line on the target which is then imaged to the streak camera slit. The ability to see the focal line of the argon laser on the frame camera allows precise collocation of the fields of view of the two cameras. The focused argon laser and the slit are confocal resulting in the ability to obtain good streak data for crystals of poor optical quality.

45 MILITARY TECHNOLOGY, WEAPONRY, AND NATIONAL DEFENSE

Refer also to citation(s) 5734, 5967

6452 (CONF-9211118–1) **Integrating real-time digital signal processing capability into a large research and development facility.** Manges, W.W.; Mallinak-Glassell, J.T.; Breeding, J.E.; Jansen, J.M. Jr.; Tate, R.M.; Bentz, R.R. Oak Ridge National Lab., TN (United States). [1992]. 29p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract AC05-84OR21400. From International conference on signal processing applications and technology; Boston, MA (United States); 5 Nov 1992. Order Number DE93003085. Source: OSTI; NTIS; GPO Dep.

The Instrumentation and Controls Division at Oak Ridge National Laboratory recently developed and installed a large scale, real-time measurement system for the world's largest pressurized water tunnel. This water tunnel, the Large Cavitation Channel (LCC) provides a research and development facility for the study of acoustic phenomena to aid in model testing of new naval ship and submarine designs. The LCC design required the development of a near-field beamformer in addition to extending the range of real-time processing capability to frequencies unavailable at other facilities. The beamformer acquires and processes time-domain acoustic data at 9.5 MB/s from up to 45 hydrophones while. The acoustic processing software provides for the real-time analysis of acoustic data. Up to 128 facility sensors are sampled, time stamped, and stored at 600 kB/s. The system generates information for acoustic phenomena and facility measurements in real time so that the operator can make facility adjustments to control the running experiment This real-time control of facility conditions requires that the measurement system integrate facility and acoustic data for simultaneous display to the operator in engineering units via high-end workstations. A dual-host minicomputer configuration

with high-end workstations connected via an Ethernet networking cluster controls and integrates measurement and display subsystems. The system architecture integrates high-performance array processors, matrix switches, signal conditioning amplifiers, antialiasing filter subsystems, high-precision analog-to-digital subsystems, high-performance data disks, and support equipment The hardware and software architecture with its distributed computers and distributed real-time data base, the signal processing algorithms and architecture, and the flexible user interface for facility and measurements integration are described in this paper.

6453 (DOE/DP–0105P) **Defense Programs.** USDOE Assistant Secretary for Defense Programs, Washington, DC (United States). [1992]. 9p. Sponsored by USDOE, Washington, DC (United States). Order Number DE92041040. Source: OSTI; NTIS; GPO Dep.

This brochure provides information on the US Department of Energy's Defense Programs. It discusses our national security responsibilities, our other activities supporting the economic and military security of the United States, and the location of our diverse scientific and technical facilities throughout the United States.

6454 (KCP–613-4826) **Electromagnetic finite element analysis of a solenoid.** Hahn, D.R. Allied-Signal Aerospace Co., Kansas City, MO (United States). Kansas City Div. Nov 1992. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00613. Order Number DE93004635. Source: OSTI; NTIS; GPO Dep.

An electromagnetic finite element study was performed on a solenoid. Flux density distributions were obtained for seven rotor positions at five-degree increments. Co-magnetic energies were computed at each position for applied coil currents of 290 and 500 milliamperes and were used to generate torque-position curves.

6455 (SAND–92-0765C) **An overview of Sandia National Laboratories' plasma switched, gigawatt, ultra-wideband impulse transmitter program.** Clark, R.S.; Rinehart, L.F.; Buttram, M.T.; Aurand, J.F. Sandia National Labs., Albuquerque, NM (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9210166–2: 4. international conference on ultra-wideband, short-pulse electromagnetics, Brooklyn, NY (United States), 8-10 Oct 1992). Order Number DE93003249. Source: OSTI; NTIS; GPO Dep.

Sandia National Laboratories has developed several repetitive, ultra-wideband (UWB), impulse transmitters to address impulse source technology and to support experimental applications. The sources fall into two different classes, pulse peaking and pulse shorting depending on how the UWB frequency components are generated. ne frequency spectrum of the radiated pulse from these sources include the spectrum of 100-MHz to 3-GHz. Depending upon the source, repetitive operation from single shot to 5-kHz (1-kHz nominal) has been obtained with excellent reliability and repeatability. SNIPER (Sub-Nanosecond impulse Radiator) is a source which uses an oil peaking switch to obtain a fast risetime (250-pS) pulse of 2-nS duration. The output voltage ranges between few tens of kilovolts to 250-kV. EMBL (EnantioMorphic Blumlein) is a similar device (presently under development) which uses a gas switch to sharpen the trailing edge of a 2-nS pulse to approximately 100-pS. To date, an output voltage of approximately 600-kV has been obtained (700- kV is the design goal). Since the frequency spectra are identical between sources with sharpened leading or trailing edges, alternatively, one can use parallel switches to short the pulse at its peak voltage. The pulse is generated externally and then injected into the antenna. Due to the high powers involved and the need to radiate a broad spectrum of frequencies, Sandia has concentrated on TEM horn. antennas with special high voltage feed adapters. Several TEM horns have been built and used during this program. In those cases where higher gains are desired for the higher frequencies, TEM horn-fed, dish antennas have been employed. An overview of the UWB transmitters, including design and operation of the modulators, the PFN'S, the pulse sharpening switches and the antennas will be presented.

6456 (SAND–92-2104C) **One-class classifiers and their application to synthetic aperture radar target recognition.** Moya, M.M.; Koch, M.W.; Fogler, R.J.; Hostetler, L.D. Sandia National Labs., Albuquerque, NM (United States). [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930355–1: Institute of Electrical and Electronic Engineers (IEEE) international conference on neural networks, San Francisco, CA (United States), 28 Mar - 1 apr 1993). Order Number DE93000716. Source: OSTI; NTIS; GPO Dep.

Target recognition requires the ability to distinguish targets from non-targets, a capability called one-class generalization. To function as a one-class classifier, a neural network must have three types of generalization: within-class, between-class, and out-of-class. We discuss these three types of generalization and identify neural network architectures that meet these requirements. We have applied our one-class classifier ideas to the problem of automatic target recognition in synthetic aperture radar. We have compared three neural network algorithms: Carpenter and Grossberg's algorithmic version of the Adaptive Resonance Theory (ART-2A), Kohonen's Learning Vector Quantization (LVQ), and Reilly and Cooper's Restricted Columb Energy network (RCE). The ART 2-A neural network has given the best results, with 100% within-class, and out-of-class generalization. Experiments show that the network's performance is sensitive to vigilance and number of training set presentations.

4501 Chemical Explosions and Explosives

6457 (LA-UR–92-3935) **Molecular modeling of slip supposed to occur in the shock initiation of crystalline PETN.** Ritchie, J.P. Los Alamos National Lab., NM (United States). [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-921101–4: Material Research Society fall meeting, Boston, MA (United States), 30 Nov - 5 dec 1992). Order Number DE93003864. Source: OSTI; NTIS; GPO Dep.

Some molecular modeling of slip using both rigid and flexible molecules of PETN in perfect, but finite, lattices has been performed. Results show that it is likely that molecular deformations occur and have an important effect in determining the shear strength.

6458 (LA-UR–92-3946) **Growth and defects of explosives crystals.** Cady, H.H. Los Alamos National Lab., NM (United States). [1992]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-921101–9: Material Research Society fall meeting, Boston, MA (United States), 30 Nov - 5 dec 1992). Order Number DE93003866. Source: OSTI; NTIS; GPO Dep.

Large single crystals of PETN, RDX, and TNT can be grown easily from evaporating ethyl acetate solutions. The crystals all share a similar type of defect that may not be commonly recognized. The defect generates conical faces ideally mosaic crystals, and may account for the "polymorphs" of TNT and detonator grades of PETN. TATB crystals manufactured by the amination of trichlorotrinitrobenzene in dry toluene entrain two forms of ammonium chloride. One of these forms causes "worm holes" in the TATB crystals that may be the reason for its unusually low failure diameters. Strained HMX crystals form mechanical twins that can spontaneously revert back to the untwinned form when the straining force is removed. Large strains or temperatures above 100°C lock in the mechanical twins.

6459 (SAND–92-2126C) **HERO resistant semiconductor bridge igniter.** Bickes, R.W. Jr. (Sandia National Labs., Albuquerque, NM (United States)); Greenway, D.; Grubelich, M.C.; Meyer, W.J.; Hartman, J.K.; McCampbell, C.B. Sandia National Labs., Albuquerque, NM (United States). [1992]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9210112–3: 29. JANNAF combustion meeting, Hampton, VA (United States), 19-23 Oct 1992). Order Number DE93002303. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The problem of accidental ignition of explosive components when exposed to radio frequency (RF) environments or radiation from other electromagnetic sources is commonly referred to as Hazards of Electromagnetic Radiation to Ordnance (HERO). One illustration of such a HERO problem is the MK149 Phalanx ammunition, which is sensitive to RF energy over a broad range of frequencies. We have demonstrated that a potential solution to the Phalanx HERO

problem consists of a semiconductor bridge (SCB) igniter that incorporates microcircuitry to protect the SCB from the RF environment. Direct RF injection and ground plane tests have demonstrated the resistance of our designs to severe RF environments.

6460 (UCRL–53943-91, pp. 47-49) **The synthesis of new, insensitive energetic materials.** Pagoria, P.F.; Coon, C.L.; Mitchell, A.R. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

The authors are synthesizing a series of new, heterocyclic, insensitive energetic materials that possess more energy than 1,3,5-triamino-2,4,6-trinitrobenzene (TATB), currently the industry standard in insensitive high explosives (IHEs). The authors have synthesized and characterized the first target compound in this series, one of few materials shown to have both sensitivity and performance properties similar to TATB.

6461 (UCRL–53943-91, pp. 50-52) **Modeling chemistry in the TOPAZ heat-flow code.** Nickels, A.L. III. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

The behavior of solid explosives at elevated temperatures is of extreme importance if the hazards associated with these materials are to be understood. Modifications to the LLNL heat-flow code TOPAZ2D incorporate the many effects of chemistry on these materials, making it applicable to a variety of important and interesting problems.

6462 (UCRL–53943-91, pp. 57-59) **Low-vulnerability composite explosives (LOVEX).** Pruneda, C.O.; Hoffman, D.M.; Jessop, E.S.; Walkup, C.M. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

The authors have an ongoing program to develop explosives with significantly lower vulnerability to battle/accident environments (bullets, fires) than conventional explosives without sacrificing performance or increasing costs. The authors have developed a composite explosive, RX-35-BX, which is made of inexpensive fillers, sodium nitrate, aluminum metal powder, and a binder system that consists of a polymeric component and an energetic liquid that acts as a plasticizer for the polymer.

4502 Nuclear Explosions and Explosives

Refer also to citation(s) 5903, 5904, 5905, 6364, 6843

6463 (SAND–92-1880C) **The performance of PAGOSA on several MIMD parallel computers.** Gardner, D.R.; Cline, D.D.; Vaughan, C.T. Sandia National Labs., Albuquerque, NM (United States). [1992]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9211128–1: 1992 nuclear explosives code developers conference, Sunnyvale, CA (United States), 2-6 Nov 1992). Order Number DE93003243. Source: OSTI; NTIS (US Sales Only); GPO Dep.

We have developed a message-passing implementation of a single-material version of the PAGOSA hydrocode which we have ported to several multiple-instruction, multiple-data stream (MIMD) parallel computers. PAGOSA is a three-dimensional, multimaterial, Eulerian, data-parallel hydrocode developed at LANL for the Connection Machine-2. Our code approximates the behavior of the multimaterial version and so provides a useftil tool for performance measurements. We have measured the performance of our MIMD version of PAGOSA on the nCUBE 2, the CM-5, and the Intel DELTA parallel computers. Our measurements are based on the simulation of a three-dimensional blast wave, and show that the unoptimized, message-passing version can run more than twice as fast as the same code running on a single processor of a Cray Y-MP for simulations with a million computational cells or more.

4505 Strategic Defense Initiative

Refer also to citation(s) 5656

6464 (DOE/EA–0621) **Environmental Assessment for the Brilliant Pebbles Tether Test at the Nevada Test Site.** USDOE Assistant Secretary for Defense Programs, Washington, DC (United States). Apr 1992. 28p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93003869. Source: OSTI; NTIS; GPO Dep.

Lawrence Livermore National Laboratory (LLNL) proposes to conduct a captive flight test of a prototype Brilliant Pebble (BP) at the Nevada Test Site (NTS). A Brilliant Pebble is a small, maneuverable, rocket powered, laser-equipped vehicle being designed to detect, track, and intercept ballistic missiles. The tests described in this Environmental Assessment would allow the vehicle to be tested at the earth's surface, before the more expensive tests in space take place. To simulate the zero gravity conditions found in space, the BP vehicle would be hung from a very high tower, allowing the vehicle to maneuver freely in the horizontal plane. To simulate tracking and interception, a way to produce rapidly approaching laser light reflections must be devised. The proposed action is to install a long line of shuttered reflectors, which would be capable of opening and closing extremely rapidly under remote control. These reflectors would be installed in a straight line leading toward, but not exactly at, the BP hanging from the tower. These reflectors would then be opened and shut in a very rapid sequence, beginning at the far end. As the BP's laser touched the sequence of opening reflectors, the return signals would appear to the BP to be the reflections from a rapidly approaching "target." An on-board computer would then calculate the speed and (apparent) trajectory of the "target," as indicated by the reflected light signals. The computer would then direct the rocket motors to fire in a specific direction to intercept the "target" as it approached the tower. The sequence of increasingly complex tasks required to suppose this test are described in detail in the following pages, along with an analysis of potential environmental, health, and safety effects.

4506 Chemical and Biological

Refer also to citation(s) 5906

54 ENVIRONMENTAL SCIENCES

6465 (ETDE-mf–93742750) **Fraunhofer Institut fuer Umweltchemie und Oekotoxikologie (IUCT). Annual report 1991.** Fraunhofer-Institut fuer Umweltchemie und Oekotoxikologie, Schmallenberg (Germany). 1992 194p. (In German). Order Number DE93742750. Source: OSTI; NTIS (US Sales Only).

The activity report 1991 of the Fraunhofer Institute for Environmental Chemistry and Ecotoxicology covers the research concept and the structure of the institute, the fields of activity and their focusses, a summary of research results, a general view at the projects and activities in cooperation with other institutes. The last part contains a detailed summary of the total report in English. (BBR).

5401 Environmental Sciences, Atmospheric

Refer also to citation(s) 4861, 4908, 4948, 5004, 5009, 5045, 5186, 5265, 5376, 5377, 5378, 5381, 5673, 5690, 5691, 5695, 5704, 5705, 5706, 5707, 5714, 5715, 5718, 5719, 5721, 5802, 5890, 5936, 6093, 6117, 6553, 6557, 6558, 6559, 6562, 6563, 6564, 6565, 6576, 6578, 6584, 6610, 6697, 6713

6466 (ANL/CP–77427) **IRP methods for Environmental Impact Statements of utility expansion plans.** Cavallo, J.D.; Hemphill, R.C.; Veselka, T.D. Argonne National Lab., IL (United States). [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9209160–21: International symposium on energy, environment and information management, Argonne, IL (United States), 15-18 Sep 1992). Order Number DE93000608. Source: OSTI; NTIS; INIS; GPO Dep.

Most large electric utilities and a growing number of gas utilities in the United States are using a planning method – Integrated Resource Planning (IRP) - which incorporates demand-side management (DSM) programs whenever the marginal cost of the DSM

programs are lower than the marginal cost of supply-side expansion options. Argonne National Laboratory has applied the IRP method in its socio-economic analysis of an Environmental Impact Statement (EIS) of power marketing for a system of electric utilities in the mountain and western regions of the United States. Applying the IRP methods provides valuable information to the participants in an EIS process involving capacity expansion of an electric or gas utility. The major challenges of applying the IRP method within an EIS are the time consuming and costly task of developing a least cost expansion path for each alternative, the detailed quantification of environmental damages associated with capacity expansion, and the explicit inclusion of societal-impacts to the region.

6467 (BNL–47623) **Molecular marker analysis as a guide to the sources of fine organic aerosols.** Rogge, W.F. (California Inst. of Tech., Pasadena, CA (United States)); Cass, G.R.; Hildemann, L.M.; Mazurek, M.A.; Simoneit, B.R.T. Brookhaven National Lab., Upton, NY (United States). Jul 1992. 6p. Sponsored by USDOE, Washington, DC (United States); Environmental Protection Agency, Washington, DC (United States); California State Government, Sacramento, CA (United States). DOE Contract AC02-76CH00016. (CONF-9207163–1: Southern California air quality study data analysis conference, Los Angeles, CA (United States), 21-23 Jul 1992). Order Number DE93002313. Source: OSTI; NTIS; INIS; GPO Dep.

The molecular composition of fine particulate ($D_p \geq 2$ μm) organic aerosol emissions from the most important sources in the Los Angeles area has been determined. Likewise, ambient concentration patterns for more than 80 single organic compounds have been measured at four urban sites (West Los Angeles, Downtown Los Angeles, Pasadena, and Rubidoux) and at one remote offshore site (San Nicolas Island). It has been found that cholesterol serves as a marker compound for emissions from charbroilers and other meat cooking operations. Vehicular exhaust being emitted from diesel and gasoline powered engines can be traced in the Los Angeles atmosphere using fossil petroleum marker compounds such as steranes and pentacyclic triterpanes (e.g., hopanes). Biogenic fine particle emission sources such as plant fragments abraded from leaf surfaces by wind and weather can be traced in the urban atmosphere. Using distinct and specific source organic tracers or assemblages of organic compounds characteristic for the sources considered it is possible to estimate the influence of different source types at any urban site where atmospheric data are available.

6468 (CEES–93000363) **The US Global Change Data and Information Management Program Plan.** Federal Coordinating Council for Science, Engineering and Technology, Washington, DC (United States). Committee on Earth and Environmental Sciences. 1992. 105p. Source: OSTI; INIS; Committee on Earth and Environmental Sciences, c/o National Science Foundation, Attn: Forms and Publications, 1800 G Street NW, Room 232, Washington, DC 20550.

The US Global Change Research Program (USGCRP) requires massive quantities of highly diverse data and information to improve our understanding of global change processes. The Committee on Earth and Environmental Sciences (CEES) comprises Federal agencies that need to provide reliable data and information for this purpose from existing programs and archives and from new activities designed to improve upon the data and information. This US Global Change Data and Information Management Program Plan commits the participating Federal agencies to work with each other, with academia, and with the international community to make it as easy as possible for researchers and others to access and use global change data and information. Toward this end, the agencies are organizing a Global Change Data and Information System (GCDIS), which takes advantage of the mission resources and responsibilities of each agency. Sources for global change data and information are national and international agency programs, including those focused on the USGCRP, such as NASA's Earth Observing System [EOS] and other agency global change initiatives and those contributing to the USGCRP from other agency programs not focused on global change. Data and information include raw data from observation systems, value-added data from data assembly activities, and derived data and information from models and other investigations. Additional data and information are identified from appropriate sources including academia and the international community.

6469 (CONF-9211115–2) **Metadata in archives: The Atmospheric Radiation Measurement (ARM) Archive experience.** Daugherty, P.F.; Singley, P.T. Oak Ridge National Lab., TN (United States). 6 Oct 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Scientific data management workshop '92; Salt Lake City, UT (United States); 3-5 Nov 1992. Order Number DE93003011. Source: OSTI; NTIS; GPO Dep.

Modern scientific research archives are charged with storing data and metadata from many sources, with organizing both the data and metadata to allow users to make a broad range of queries, and with describing the archived data well enough to make it useful. This discussion of our experiences with the ARM Archive illustates some of the uses of metadata, and some of the issues surrounding developing and managing metadata in an archival setting.

6470 (DOE/EIS–0157-Exec.Summ.) **Final Environmental Impact Statement and Environmental Impact Report for continued operation of Lawrence Livermore National Laboratory and Sandia National Laboratories, Livermore: Executive summary.** USDOE San Francisco Field Office, Oakland, CA (United States); California Univ., Livermore, CA (United States). Aug 1992. 71p. Sponsored by USDOE, Washington, DC (United States). (SCH–90030847). Order Number DE93003128. Source: OSTI; NTIS; INIS; GPO Dep.

The US Department of Energy (DOE) and the Regents of the University of California (UC) propose the continued operation, including near-term proposed projects, of the Lawrence Livermore National Laboratory (LLNL). In addition, DOE proposes the continued operation, including near-term proposed projects, of Sandia National Laboratories, Livermore (SNL, Livermore). Continued operation plus proposed projects at the two Laboratories is needed so that the research and development missions established by Congress and the President can continue to be supported. As provided and encouraged by the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA), DOE and UC have prepared this document as a joint Environmental Impact Statement (EIS) and Environmental Impact Report (EIR) to analyze the impacts of the proposed action. In addition, this document discusses a no action alternative for continuing operations at FY 1992 funding levels without further growth, a modification of operations alternative focused on specific adverse environmental impacts of operations or facilities, and a shutdown and decommissioning alternative. This document also examines the alternative of UC discontinuing its management of LLNL after the current contract expires on September 30, 1992. The environmental documentation process provides information to the public, government agencies, and decision makers about the environmental impacts of implementing the proposed and alternative actions. In addition, this environmental documentation identifies alternatives and possible ways to reduce or prevent environmental impacts. A list of the issues raised through the EIS/EIR scoping process is presented.

6471 (DOE/ER–0568T) **Atmospheric Sciences Program: Summaries of research in FY 1992.** USDOE Office of Energy Research, Washington, DC (United States). Environmental Sciences Div. Nov 1992. 55p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93004891. Source: OSTI; NTIS; GPO Dep.

The mission of the Department's Environmental Processes and Effects Research (EPER) Program, in which the Atmospheric Science Program resides, is to (1) quantify the physical, chemical, geological, and biological processes that transport, disperse, and transform energy-related materials in the atmosphere and in terrestrial and marine co-systems; (2) to determine the mechanisms of degradation and detoxification of hazardous energy related materials in the environment; and (3) to determine and manage the capacity for ecosystem adjustments to energy-related environmental stresses. This publication describes research on atmospheric chemistry.

6472 (DOE/ER/60971–3) **ICRCCM Phase 2: Verification and calibration of radiation codes in climate models: Technical report, 1 November 1991–1 December 1992.** Ellingson, R.G.; Wiscombe, W.J.; Murcray, D.; Smith, W.; Strauch, R. Maryland Univ., College Park, MD (United States). Dept. of Meteorology. [1992]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-90ER60971. Order Number DE93005114. Source: OSTI; NTIS; GPO Dep.

Following the finding by the InterComparison of Radiation Codes used in Climate Models (ICRCCM) of large differences among fluxes predicted by sophisticated radiation models that could not be sorted out because of the lack of a set of accurate atmospheric spectral radiation data measured simultaneously with the important radiative properties of the atmosphere, our team of scientists proposed to remedy the situation by carrying out a comprehensive program of measurement and analysis called SPECTRE (Spectral Radiance Experiment). The data collected during SPECTRE form the test bed for the second phase of ICRCCM, namely verification and calibration of radiation codes used in climate models. This should lead to more accurate radiation models for use in parameterizing climate models, which in turn play a key role in the prediction of trace-gas greenhouse effects. This report summarizes the activities of our group during the project's Third year to meet our stated objectives. The report is divided into three sections entitled: SPECTRE Activities, ICRCCM Activities, and summary information. The section on SPECTRE activities summarizes the field portion of the project during 1991, and the data reduction/analysis performed by the various participants. The section on ICRCCM activities summarizes our initial attempts to select data for distribution to ICRCCM participants and at comparison of observations with calculations as will be done by the ICRCCM participants. The Summary Information section lists data concerning publications, presentations, graduate students supported, and post-doctoral appointments during the project.

6473 (DOE/ER/61010–2) **A prompt start: Implementing the framework convention on climate change.** Chayes, A. (Harvard Univ., Cambridge, MA (United States). Law School); Skolnikoff, E.B.; Victor, D.G. Harvard Univ., Cambridge, MA (United States). Law School. [1992]. 33p. Sponsored by USDOE, Washington, DC (United States); Rockefeller Foundation, New York, NY (United States). DOE Contract FC03-90ER61010. (CONF-9201121–Summ.: Institutional aspects of international cooperation on climate change, Bellagio (Italy), 28-30 Jan 1992). Order Number DE93005062. Source: OSTI; NTIS; INIS; GPO Dep.

A Framework Convention on Climate Change is under active negotiation in the United Nations with the expectation it will be ready for Signature at the Rio Conference this June. Under the most optimistic projections, a Convention will not come into force and be an effective instrument for months, probably years. In recognition of the several institutional tasks that will be of crucial importance whatever the detailed content of the Convention a small group of high international organizations involved in the negotiations was convened at the Rockefeller Foundation's Conference Center at Bellagio in January. The discussions at Bellagio on the need for a Prompt Start on these institutional tasks benefitted from earlier meetings at Harvard in March and at Bermuda in May, 1991, that the co-organizers convened to discuss these and related aspects of the negotiations on a Climate Convention. Those meetings were attended by members of the academic community, officials from the United Nations, and representatives of governments involved in the negotiations.

6474 (DTH-LET-RE–91-5) **Individual and public transportation: Emissions and energy consumption models.** Sorenson, S.C.; Schramm, J. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Energiteknik. Jan 1992. 62p. Order Number DE93752748. Source: OSTI; NTIS.

The report covers three projects the aim of which was to evaluate the relative air pollution from traffic relative to public and private transportation, to quantify the effects of adoption of different traffic regulating policies on air pollution on the road, to predict on-street emission levels with the use of traffic data, emission models for vehicles and dispersion models - and to evaluate emissions in city traffic on highways and freeways. It was thus necessary to be able to calculate the emissions from, and energy consumption of, different vehicles under diverse traffic conditions. A series of computer models were made. These models, and the basic assumptions underlying them, are described. The programmes were developed to predict HC, CO and NO_x particles and CO_2, as well as fuel consumption, by petrol powered passenger cars (with and without 3-way catalysts) diesel powered light duty vehicles and heavy duty diesel powered vehicles (of 10 - 26 tons). The models are valid for up to 150 km/h for light duty and 105 km/h for heavy duty vehicles. Deterioration factors for HC, CO and NO_x emissions from cars equipped with 3-way catalysts are presented. Simple models for cold start incremental emission of CO, HC and CO_2 and incremental cold start fuel consumption regarding cars are presented. There is a degree of uncertainty in the catalyst car models at speeds over 90-100 km/h. Detailed figures on emissions and fuel consumption factors are presented. (AB) (31 refs.).

6475 (ECN-C–92-032) **Costs of CO_2 reduction technologies for the Netherlands.** Van Harmelen, T.; Ybema, J.R. Netherlands Energy Research Foundation (ECN), Petten (Netherlands). Jun 1992. 32p. Project ECN 7067. Order Number DE93752679. Source: OSTI; NTIS (US Sales Only).

This study is also presented as a chapter in the IES (Institute for Environmental Studies) report 'Cost of greenhouse abatement in the Netherlands' by T. van der Burg, T. van Harmelen, and J.R. Ybema.

UNEP (United Nations Environmental Programme) has recently launched a project aimed at establishing a set of methodological guidelines for calculating the costs of limiting greenhouse gas (GHG) emissions, particularly carbon dioxide emissions from the energy sector. This paper contains the contribution of the Business Unit ESC-Energy Studies of the Netherlands Energy Research Foundation (ECN) to the first phase of the UNEP-study. Four important bottom-up technology oriented CO_2 emission reduction studies are reviewed. Attention is paid to the methodology, the type of costs, the technological reduction options, and the evaluated CO_2 emission reduction targets. The aim is to explain systematically the differences in CO_2 emission reduction technology cost curves for the Netherlands, generated by different scenarios for the year 2010. In chapter two descriptions are given of the methodologies, used in the studies and the limitations of the formats of the model outputs. In chapter three a characterization of the four studies and a comparison of the results are made. In chapter four two studies on the costs of CO_2 emission reduction in the Netherlands in the year 2010 are dealt with. 3 figs., 3 tabs., 3 app.

6476 (ETDE/JP-mf–93753679) **111th meeting for research of safety engineering.** Japan Society for Safety Engineering, Tokyo (Japan). 27 Jul 1992 8p. (In Japanese). Order Number DE93753679. Source: OSTI; NTIS.

The 111th meeting for research of safety engineering was held on 27th July, 1992. The topic presented by Igawa of Kanagawa university has been movement and effect of acid materials in the environmental atmosphere. Further, Hyomi of Japan environmental health center has made presentation on the present condition of environmental pollution in Japan and East Asian countries, mainly emphasizing to atmospheric pollution. According to former presentation, the main acid materials contained in the pollutants released in the atmosphere are sulfur oxides and nitrogen oxides. The fallout of acid materials are represented by acid rain and acid fog, and they have environmental effects such as; direct effect to human body, destruction of forest, acidification of lakes and marshes, and pollution of outdoor sculptures and construction materials. It is cited that the termination of the source for pollution is necessary to solve the pollution problems. As for the later topic, the presentation is made on the results of direct investigation of atmospheric pollution problems faced by Taiwan, Thailand and China since 1980's. 1 fig., 1 tab.

6477 (ETDE/JP-mf–93753679, pp. 1-3) **Behavior and effects of acid materials of environmental atmosphere.** Igawa, M. (Kanagawa University, Yokohama (Japan). Faculty of Engineering). Japan Society for Safety Engineering, Tokyo (Japan). 27 Jul 1992. 8p. (In Japanese). In *111 th meeting for research of safety engineering.* Order Number DE93753679. Source: OSTI; NTIS (US Sales Only).

The main acid materials in the pollutants produced in the atmosphere are sulfur dioxide produced by the oxidation of sulfur present in the fuel during burning and the nitrogen oxides formed by the reaction of nitrogen and oxygen in the atmosphere at high temperature burning. The environmental effects of acid fallout are appeared as destruction of forest, acidification of lakes and marshes, and corrosion of outdoor sculptures and construction materials. Among the above mentioned effects, the effects of acid fallout on plants is complicated and they are thought as direct effect and effect due to soil acidification. pH of lakes, marshes and rivers is maintained from 7 to 8 inspite of the acidification of the rain, and this is because of the buffering effect of the soil. However there is limitation in the buffering action of the soil. Fog has eliminated acid materials from the atmosphere causing purification, on the other hand highly concentrated pollutants are accumulated in the plants by fog, and the effect of fog on plants is extremely serious. Cut off of the pollution source is very important to solve the acid materials fallout problems. 1 fig., 1 tab.

6478 (ETDE/JP-mf–93753679, pp. 4-8) **Present state of environmental pollution in Japan and East Asian Countries.: Atmospheric pollution.** Himi, K. (Japan Environmental Sanitation Center, Kawasaki (Japan)). Japan Society for Safety Engineering, Tokyo (Japan). 27 Jul 1992. 8p. (In Japanese). In *111 th meeting for research of safety engineering.* Order Number DE93753679. Source: OSTI; NTIS (US Sales Only).

Authors have studied atmospheric pollution in Japan, and they have also investigated atmospheric pollution problems of Taiwan, Thailand and China since 1980's. General condition of atmospheric pollution reported on 1990 by Chinese National Environmental Protection Bureau has been that the atmospheric pollution in big and medium cities has been comparatively severe, and the atmospheric pollution of small cities is also showing a growing tendency. Further, the acid rain has been limited to the above mentioned areas, however spreading tendency is reported. The simple yearly average value of the concentration of sulfur dioxide measured at 1965, as a year of first measurement, by Japan National Atmospheric Pollution Measurement Bureau was 0.06ppm and at present, it has been improved to 0.01ppm. The main reasons for atmospheric pollution in Thailand are burning of fuel in the factories and transportation facilities. Transportation facilities are big consumers of energy and this has been the main reason for atmospheric pollution in urban areas. According to Taiwan's regional atmospheric pollution condition of 1990, the amount of soot fallout is higher in thickly populated and industrialized areas like Taipei city and Takao city, and the amount of monthly fallout is about 14t/km^2.

6479 (ETDE-mf–93742697) **Reduction of hydrocarbon emissions during car-refueling by using stage II vapour balance systems. Final report.** Heine, K. Weigmann (Hermann) Internationale Spedition, Berlin (Germany); Umweltbundesamt, Berlin (Germany). [1992] 21p. (In German). Contract UBA 2047;50441-9/24. Order Number DE93742697. Source: OSTI; NTIS (US Sales Only).

Subject of the following report is the retrofitting of the dispensing systems of a gasoline station by installing "balanced displacement systems". The in use experience over a period of 12 months is described. The acceptance of the refueling vapour balance by the user is reported. The investment costs and working expenses for this project are given in detail. (orig.).

6480 (ETDE-mf–93742761) **Dust reduction and denitrification of the waste gas from gas-fired glass melting tanks in plant Neuburg. Final report.** Abraham, D.; Krause, W.; Raithore, P.B. Oberland Glas AG, Bad Wurzach (Germany); Umweltbundesamt, Berlin (Germany). Dec 1991 121p. (In German). Contract UFOPLAN-Nr. 50441-2/53. Order Number DE93742761. Source: OSTI; NTIS (US Sales Only).

The waste gas of three gas fired glasmelting tanks are cleaned by injection of calcium hydroxide powder and precipitating in two field electrostatic filter. Subsequently they are treated with ammoniac water in the succeeding zeolite catalyst. Dentrification at 380degC works in principle with high efficiency but during the long test period it was not possible to find a satisfactory solution and a long-term stability for the dust cleaning on the surface-layer of dust on the catalyst. The dust coming from the electrostatic precipitator was recycled to the glasmelting furnace. (orig.).

6481 (ETDE-mf–93744267) **Climatic conditions in Bavarius under the aspect of new forest damages (continuation). Final report.** Mayer, H.; Schmidt, J. Muenchen Univ. (Germany). Lehrstuhl fuer Bioklimatologie und Angewandte Meteorologie; Bayerisches Staatsministerium fuer Landesentwicklung und Umweltfragen, Muenchen (Germany). 31 Jan 1991 128p. (In German). Contract BStLU 6495-953-23329. Order Number DE93744267. Source: OSTI; NTIS (US Sales Only).

The research project about 'Climatic conditions in Bavaria under the aspect of new forest damages' is continued mainly in order to work out a basis for assessing extreme weather conditions and -processes over the last three to four decades. Frost and dry stress is to be analysed for its impact on development and graveness of new forest damage. The general aim is to process climatic data and provide condensed information and/or results for current and future research projects within which the relevance of the climate and weather for the forest may play an important role. (orig.).

6482 (ETDE-mf–93744281) **Environmental dioxins and furans in Hesse. Measuring results from Hesse.** Umweltplanung, Arbeits- und Umweltschutz. Schriftenreihe der Hessischen Landesanstalt fuer Umweltschutz. Buechen, M.; Eickhoff, W.; Engler, M.; Haeckl, M.; Kummer, V.; Seel, P.; Weidner, E. Hessische Landesanstalt fuer Umwelt, Wiesbaden (Germany); Hessisches Landesamt fuer Bodenforschung, Wiesbaden (Germany). Aug 1991 154p. (In German). Order Number DE93744281. Source: OSTI; NTIS (US Sales Only).

This report on 'Environmental dioxins an furans in Hesse' contains the results of dioxin measurements carried through in Hessen in the media atmosphere, soil, water, waste, vegetation, and milk, thereby informing on the state of environmental dioxin pollution in Hesse. Explanations and interpretations are offered with the aim to make the isolated, individual items of information into an overall picture of environmental dioxin pollution. (orig./EF).

6483 (ETDE-mf–93744328) **Polybromide dibenzo dioxine (PBDD). Polybromide dibenzo furane (PBDF).** Umweltbundesamt, Berlin (Germany). Feb 1989 15p. (In German). Order Number DE93744328. Source: OSTI; NTIS (US Sales Only).

In the decomposition of plastics which are equipped with flame protection materials containing polybromide diphenyl ether, very high rates of formation of furane are observed (e.g.: above 100,000,000 ppb PBDF). Therefore fires on these plastic products are regarded as considerably more problematical than, for example, PCB transformer fires (with the consequences and the necessary measures, such as dioxin/furane analysis, cleaning up fires with full breathing apparatus, removing the contaminated residues of fires). Polymbromide dibenzo furane is also formed and released in normal processing of these plastics, but in smaller quantities than in a fire. PBDF was detected at the workplace and in the extracted air flow. (orig.).

6484 (ETDE-mf–93744398) **Reactions of NO_3/N_2O_5 with biogenic organic hydrocarbons. Final report.** Forschungsberichte zum Forschungsprogramm des Landes Nordrhein-Westfalen 'Luftverunreinigungen und Waldschaeden'. Barnes, I.; Bastian, V.; Becker, K.H.; Zhu Tong. Wuppertal Univ. (Gesamthochschule) (Germany). Lehrgebiet Physiaklische Chemie; Ministerium fuer Umwelt, Raumordnung und Landwirtschaft des Landes Nordrhein-Westfalen, Duesseldorf (Germany). Mar 1992 44p. (In German). Contract FP 10. Order Number DE93744398. Source: OSTI; NTIS (US Sales Only).

Within the framework of the project rate coefficients and products of the reactions of NO_3-radicals with biogenic hydrocarbons have been investigated. Further, the OH-reactions and photolysis of reaction intermediates have also been investigated. From these studies reaction mechanisms have been derived which allow estimates to be made of the importance of nighttime NO_3-oxidation processes compared to daytime OH-radical chain oxidation processes. In collaboration with a laboratory in the Chemical Industry 'screening-tests' have been performed on the keto nitrates and dinitrates which are products of NO_3-reactions to test for phytotoxic properties of these compounds. During the germination phase of

the test plants low but clear indications of phytotoxicity caused by the organic nitrates was established. The reactions of NO_3-radicals and the resulting product are probably not directly involved in the presentday forest damage, however, they certainly influence atmospheric oxidation processes, also those occurring over forest areas. (orig.) With 51 refs., 11 tabs., 9 figs.

6485 (ETDE-mf–93744522) **Measurement of absorption cross sections and quantum yields of various photoactive tropospheric trace gases.** Moortgat, G.K.; Meller, R.; Raber, W.; Reinholdt, K. Max-Planck-Institut fuer Chemie (Otto-Hahn-Institut), Mainz (Germany). Abt. Luftchemie; Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Apr 1992 181p. (In German). Contract BMFT 07EU703. Order Number DE93744522. Source: OSTI; NTIS (US Sales Only).

Photolytic parameters of a number of photoactive carbonyl compounds were determined: Methylethyl ketone $CH_3COC_2H_5$ (MEK) from butane photooxidation; methylvinyl ketone $CH_2=CHCOCH_3$ (MVK), methacrolein $CH_2=C(CH_3)CHO$ (MACR) and methylglyoxal CH_3COCOH (MGLY) produced as intermediates during isoprene degradation in the lower troposphere. Absorption cross sections were measured with a diode line spectrometer. While MEK absorbs only between 200 and 330 nm, MVK and MACR have absorption bands up to about 395 nm. MGLY absorbs up to the visible range (490 nm). The temperature dependence of the absorption cross sections of formaldehyde (HCHO) was re-measured with a resolution of 0.02 nm. The values are presented in a table in the appendix. (EF).

6486 (ETDE-mf–93744925) **Modal structure of variations in the tropical climate system. Pt. 1. Observations.** Max-Planck-Institut fuer Meteorologie. Report. Latif, M. (Max-Planck-Institut fuer Meteorologie, Hamburg (Germany)); Barnett, T.P.; Mizuno, K. Max-Planck-Institut fuer Meteorologie, Hamburg (Germany). Sep 1992 28p. Order Number DE93744925. Source: OSTI; NTIS (US Sales Only).

We have investigated the modal structure of climate variability in the tropical Pacific by analyzing zonal surface wind stress, sea surface temperature, and upper ocean heat content during the period 1967 to 1986. Three principal climate modes could be indentified: The annual cycle, a quasi-biennial (QB) mode, and a low-frequency (LF) mode with a time scale of about 3 years. The annual cycle is mostly governed by the movement of the sun, local air-sea heat exchange and mixing processes. In the eastern equatorial Pacific, the annual cycle involves a westward propagating coupled mode which is caused by processes within the surface mixed layer. The quasi-biennial mode near the equator shows aspects of both mixed layer physics and shallow water wave dynamics and is therefore best described as a 'mixed surface/subsurface dynamics' mode. Poleward of 10 degrees local air-sea heat exchange and mixing processes become also important. The low-frequency mode is the traditional ENSO mode, which is best described as the oceanic response to low-frequency atmospheric forcing. Equatorial wave dynamics is crucial for the low-frequency mode. The quasi-biennial mode shows some evidence for a phase-locking to the annual cycle. However, the period of the quasi-biennial mode is not steady, ranging from about 20 to 30 months during the analysed period. Evidence was found that the annual cycle and the quasi-biennual mode together influence the low-frequency mode such that the low-frequency mode attains maximum amplitude several months after the annual cycle and the quasi-biennial mode were in phase. Our study confirms also the existence of non-linear interactions involving the QB and LF modes of interannual variability only. (orig.).

6487 (ETDE-mf–93744926) **The Koeppen climate classification as a diagnostic tool for general circulation models.** Max-Planck-Institut fuer Meteorologie. Report. Lohmann, U. (Max-Planck-Institut fuer Meteorologie, Hamburg (Germany)); Bengtsson, L.; Roeckner, E.; Sausen, R.; Cubasch, U.; Perlwitz, J. Max-Planck-Institut fuer Meteorologie, Hamburg (Germany). Oct 1992 25p. Order Number DE93744926. Source: OSTI; NTIS (US Sales Only).

The Koeppen climate classification has been applied to the output of atmospheric general circulation models and coupled atmosphere-ocean circulation models. The classification is used for a validation of the control runs of the present climate and for an analysis of greenhouse gas warming simulations. The most prominent results of the global warming computations are the retreat of regions of Permafrost and the increase of areas with Tropical Rainy Climates and Dry Climates. (orig.).

6488 (ETDE-mf–93750259) **The Antarctic ice sheet and environmental change: A three-dimensional modelling study.** Berichte zur Polarforschung. Huybrechts, P. (Vrije Univ. Brussels (Belgium). Geografisch Inst.). Alfred-Wegener-Institut fuer Polar- und Meeresforschung, Bremerhaven (Germany). 1992 245p. Order Number DE93750259. Source: OSTI; NTIS (US Sales Only).

This thesis addresses the response of the antarctic ice sheet to changes in environmental conditions, both on the longer palaeoclimatic time scale (10^4-10^5 y) as on the shorter time scale (10^2 y) associated with future greenhouse warming. The Antarctic ice sheet is of large interest because changes in its elevation and extent have an important role in modulating global atmosperic and oceanographic processes, and because these fluctuations contribute significantly to world-wide sea levels. The possibility of a surge of the marinebased West Antarctic ice sheet is often mentioned as an important aspect. In a first part a qualitative description is given of the role of the ice sheet in the global environmental system and the possible modes of interaction are discussed. An overview is also presented of the ice sheet's glacial history and of available field evidence of ice sheet expansion during the last glacial cycle. Subsequently, the Antarctic ice sheet is investigated using a high-resolution 3-D flow model covering the entrie ice domain. This model incorporates a coupled ice shelf, grounding-line dynamics, basal sliding and isostatic bed adjustment. It has a full coupling between thermal field and ice flow and the ice sheet geometry is freely generated in response to specified environmental conditions. The model is driven by changes in sea level, surface temperature and mass balance. (orig.).

6489 (ETDE-mf–93750990) **Development of sampling techniques suitable in field applications for the speciation of chemically and hygienically relevant atmospheric pollutants: nitric acid and hydrogen peroxide. Final report.** Forschungsberichte zum Forschungsprogramm des Landes Nordrhein-Westfalen 'Luftverunreinigungen und Waldschaeden'. Moelleken, H.; Scopzak, D.; Hartkamp, H. Wuppertal Univ. (Gesamthochschule) (Germany). Fachbereich 9 - Naturwissenschaften 2 - Chemie - Biologie; Ministerium fuer Umwelt, Raumordnung und Landwirtschaft des Landes Nordrhein-Westfalen, Duesseldorf (Germany). Jun 1992 64p. (In German). Contract VB 5-8819.3.6. Order Number DE93750990. Source: OSTI; NTIS (US Sales Only).

Using airborne hydrogen peroxide and airborne nitric acid as examples, two new devices for manual discontinuous and for automatic continuous sampling of atmospheric trace constituents have been developed and described with respect to their performance characteristics: the gas sample injector and the high-volume helix absorber, the former being presented in two versions mainly in view of handling in field applications. The high-volume helix reactor represents the prototype of a sampling system enabling continuous enrichment of the trace constituent under consideration. It may preferentially be used in automatic air quality monitoring stations. In both cases, the practical applicability depends on the availability of suitable reaction systems. For hydrogen peroxide, the fast and almost specific complex forming reaction between hydrogen peroxide and the dipicolinato-dioxo-vanadium(V)-chelate has been used for collection and measurement. One major pre-requisite for the described sampling techniques are reliable calibration standards. Methods have been developed and characterized for the dynamic preparation of high quality calibration gas standards with excellent reproducibility and longterm stability, containing hydrogen peroxide or gaseous nitric acid as trace constituents, the concentrations of which covering several orders of magnitude. The methods for preparation of calibration standards may also be used in automatic monitoring stations. (orig.) With 45 refs., 13 tabs., 28 figs.

6490 (GSF–4/92, pp. 1-6) **Airborne acid pollution of beech and spruce stands in Hungary (Sopron) and Hessen (Witzenhausen).** Balazs, A.; Fuehrer, R. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany). Inst. fuer

Oekologische Chemie. 1992. (In German). (CONF-9104400--: International symposium on ecological approaches of environmental chemicals, Debrecen (Hungary), 15-17 Apr 1991). In *Ecological approaches of environmental chemicals. Proceedings.* 443p. Order Number DE93750725. Source: OSTI; NTIS (US Sales Only); INIS.

The results presented show clearly that the assessment of acid pollution of forest ecosystems cannot rely exclusively on the determination of free protons by pH measurements. Only after including the area of the tree crowns can airborne acid pollution of forest stands be realistically assessed. Furthermore it is to be assumed that ammonia pollution may be very important not only in the vicinity of pollutant sources but also, in part, on long-range pollutant transport. This is why not only cuts in SO_2 and NO_x emissions, but also in NH_3 emissions should be given high priority. (orig.).

6491 (GSF–4/92, pp. 90-99) **Importance of precipitation deposition in the field and in forest ecosystems.** Fuehrer, E. (Forstwissenschaftliches Inst., Sopron (Hungary)). GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany). Inst. fuer Oekologische Chemie. 1992. (In German). (CONF-9104400--: International symposium on ecological approaches of environmental chemicals, Debrecen (Hungary), 15-17 Apr 1991). In *Ecological approaches of environmental chemicals. Proceedings.* 443p. Order Number DE93750725. Source: OSTI; NTIS (US Sales Only); INIS.

The amount of atmospheric pollution and acid deposition in forest ecosystems can be determined by analyzing not only precipitation water in the field but also the chemical composition of crown throughfall. In western Hungary, chemical measurements of precipitation in a beech forest, an oak forest and a spruce forest revealed the following: the spruce ecosystem is most endangered in terms of acid pollution, with the oak ecosystem ranking second and the beech ecosystem third. The three-year observations described served to gather data only. The variations and differences between the analyses of precipitation in the field and crown throughfall in stands are explained in part by air pollution and in part by physiological processes not yet known completely. They point to the complexity of judging problems in the sector of acidification and to the need for conducting relative studies. (orig.).

6492 (GSF–5/92) **Assessment of exposure-relevant substance properties.** Brueggemann, R. (GSF-Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany). Projektgruppe Umweltgefaehrdungspotentiale von Chemikalien (PUC)); Muenzer, B.; Altschuh, J. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany). Jan 1992. 39p. (In German). Order Number DE93742654. Source: OSTI; NTIS (US Sales Only).

Mathematical models for simulating the behavior of chemicals in the environment require input of both data regarding environmental properties, and the chemicals to be studied. Among substance data, physico-chemical properties and information on reactivity, especially regarding biodegradation, are most important. However, these data are not known to the extent required for the majority of environmentally relevant compounds. From this arises the necessity to provide methods for assessing exposure-relevant substance data. This report presents the computer program DTEST, a program for assessing physico-chemical properties such as solubility in water or partition coefficients via property-property relations. DTEST disposes over a net of such relations, permitting automated operation on the basis of the data available for the individual case and - consequently - processing of comprehensive lists of substances. Moreover, known (experimental) data can be subjected to a plausibility check by means of a special routine. Regarding biodegradation, a method is discussed for transforming verbal characterizations of the biodegradation of chemicals as they are frequently encountered in literature into speed constants for first order reactions. The program RLTEC, finally, permits to determine the entrance pathways of chemicals into the environmental media air, water and soil, and to make rough assessments of the respective mass flows. (orig.).

6493 (GSF–26/91, pp. 41-63) **Time trend of tropospheric ozone in the area of the Bavarian Calcareous Alps.** Seiler, W. (Fraunhofer-Inst. fuer Atmosphaerische Umweltforschung (IFU), Garmisch-Partenkirchen (Germany)). GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Bayerisches Staatsministerium fuer Landesentwicklung und Umweltfragen, Muenchen (Germany). Aug 1991. (In German). (CONF-9102189--: 2. status seminar of Projektgruppe Bayern zur Erforschung der Wirkung von Umweltschadstoffen (PBWU) on forest decline, Neuherberg (Germany), 4-6 Feb 1991). In *Second status seminar of the 'Bavarian Project Group on Research into the Effect of Environmental Pollutants (PBWU)' on the major research area 'forest decline'. Proceedings.* 553p. Order Number DE93742762. Source: OSTI; NTIS (US Sales Only).

Increases in ozone concentration are caused by photochemical degradation of hydrocarbons under the impact of nitrogen oxides. During periods of smog, the concentration of ozone in the lower troposphere increases. High ozone concentrations go along with high concentrations of hydrocarbons, OH radicals and other photochemical oxidants. Photolysis in the stratosphere results in ozone depletion with the formation of molecular oxygen. (EF).

6494 (GSF–26/91, pp. 265-281) **Project 'altidudinal gradient Zillertal' in the Tyrol.** Smidt, S. (Forstliche Bundesversuchsanstalt, Vienna (Austria)); Herman, F. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Bayerisches Staatsministerium fuer Landesentwicklung und Umweltfragen, Muenchen (Germany). Aug 1991. (In German). (CONF-9102189--: 2. status seminar of Projektgruppe Bayern zur Erforschung der Wirkung von Umweltschadstoffen (PBWU) on forest decline, Neuherberg (Germany), 4-6 Feb 1991). In *Second status seminar of the 'Bavarian Project Group on Research into the Effect of Environmental Pollutants (PBWU)' on the major research area 'forest decline'. Proceedings.* 553p. Order Number DE93742762. Source: OSTI; NTIS (US Sales Only).

The project 'altitudinal gradient Zillertal' in the Tyrol is a contribution to Austrian research on forest ecosystems. Investigated were, between 1984 and 1990, especially the condition of the forest, the stress situation, the suitability of biochemical tests and investigations of needle anatomy as methods for early detection of stress, and the dependence of different parameters on altitude above sea level. SO_2 and NO_x, atmospheric acids and ions dissolved in acidic precipitations decreased with altitude above sea level while H^+ and ozone increased (with swells at 1000-2000 metres). Nutrient supply of soil and needles was poor; N and Mg decreased with increasing altitude. Seasonal and stress-related changes in photosynthesis - which does not seem to be ozone - sensitive - were investigated. (orig./UWA).

6495 (GSF–26/91, pp. 311-320) **Micrometeorology and vertical gradients of air pollutants in a spruce stand of the Bavarian Forest National Park.** Enders, G. (Muenchen Univ. (Germany). Lehrstuhl fuer Bioklimatologie und Angewandte Meteorologie); Piper, S.; Jakobi, G.; Teichmann, U. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Bayerisches Staatsministerium fuer Landesentwicklung und Umweltfragen, Muenchen (Germany). Aug 1991. (In German). (CONF-9102189--: 2. status seminar of Projektgruppe Bayern zur Erforschung der Wirkung von Umweltschadstoffen (PBWU) on forest decline, Neuherberg (Germany), 4-6 Feb 1991). In *Second status seminar of the 'Bavarian Project Group on Research into the Effect of Environmental Pollutants (PBWU)' on the major research area 'forest decline'. Proceedings.* 553p. Order Number DE93742762. Source: OSTI; NTIS (US Sales Only).

General structure as well as variability of trace gas profiles within and above mature forests must be known to learn to what degree those substances may contribute to the recent forest decline. While certain aspects of the development and variation of profiles can be interpreted my means of simultaneous micrometeorological measurements, no real understanding of the mechanisms and processes behind can be achieved in many cases, as is shown by some examples for SO_2, O_3 and NO_x profiles. Therefore, efforts have been made to cooperate with other groups to move beyond a pure description of phenomena and study also chemical reactions of a forest atmosphere in detail. At present interdisciplinary joint experiments focuss on interactions of ozone and biogenic hydrocarbons including relevant precursors and reactions products. (orig.).

6496 (GSF–26/91, pp. 321-333) **Origin, behaviour and deposition of reaction products in gaseous, particle, and drop form.** Dlugi, R. (Muenchen Univ. (Germany). Meteorologisches Inst.); Roider, G. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Bayerisches Staatsministerium fuer Landesentwicklung und Umweltfragen, Muenchen (Germany). Aug 1991. (In German). (CONF-9102189–: 2. status seminar of Projektgruppe Bayern zur Erforschung der Wirkung von Umweltschadstoffen (PBWU) on forest decline, Neuherberg (Germany), 4-6 Feb 1991). In *Second status seminar of the 'Bavarian Project Group on Research into the Effect of Environmental Pollutants (PBWU)' on the major research area 'forest decline'. Proceedings.* 553p. Order Number DE93742762. Source: OSTI; NTIS (US Sales Only).

Different results of a study are presented to analyse the influence of turbulent transport on chamical reactions in a forest area. The transport is controlled by intermittent turbulence. A method is presented to calculate from measured data the transport times T_t and the characteristic reaction time T_r within and above the canopy. For many chemical reactions $T_t >$ or approx. T_r is valid, which shows a considerable influence of transport processes on chemical reaction cycles inside the canopy. In the trunk space the chemical removal of terpenes is mainly controlled by the NO_3-radical. It is discussed that the NO_3-concentration is influenced by the sources of NO and NO_2 at the soil and the deposition of HNO_3. In conclusion a new method is shortly described, to parameterize the turbulent exchange processes in plant canopies and to estimate T_t in terms of flow characteristics of the atmosphere. (orig.).

6497 (IA–1462) **Mathematical inversion of multiple-scattering of laser light.** Bnayahu, Yair (Israel Atomic Energy Commission, Yavne (Israel). Soreq Nuclear Research Center). Hebrew Univ., Jerusalem (Israel). Aug 1992. [112] (In Hebrew). Order Number DE93609128. Source: OSTI; NTIS (US Sales Only); INIS.

This work is divided in three parts: In the first part a model for evaluating the multiple scattering contribution, as a function of particle properties, to optical measurement systems (as LIDAR or particle-counters) is developed. This model, based on 'Successive Singular Scattering' method, uses the Monte-Carlo approach to calculate all multiple-scattering orders. Application of this model to LIDAR systems was found to agree with results obtained by previous accepted models. The advantage of our model is that it can handle multiple-scattering computations in off-axis geometries and is not limited therefore to monostatic systems (where the light propagation direction and the detector field-of-view are on the same axis). The second and third part of this work discuss different aspects of mathematical inversion of optical measurements containing multiple-scattering.

6498 (IAEA-R–5468-F) **Development of a reference method and sampling system for continuous monitoring of environmental HT and HTO concentration in the air: Final report for the period 15 December 1988 - 14 December 1990.** Uchrin, G. (Magyar Tudomanyos Akademia, Budapest (Hungary). Izotopintezete). International Atomic Energy Agency, Vienna (Austria). Jun 1992. [53] Order Number DE93609101. Source: OSTI; NTIS (US Sales Only); INIS.

A differential sampling system to monitor environmental Tritiated Water Vapour (HT) and Tritiated Hydrogen Gas (HTO) concentrations in the atmosphere was developed and tested. The sampler consists of an aerosol filter, diaphragm pump, absorption trap for HTO (molecular sieve), supply of H_2 carrier (electrolysis unit), conversion trap for HT (Pd-impregnated molecular sieve), flow meter and gas meter. The sampler operates with a flow rate between 30 and 80 1/h, with a typical sampling period of one week. Vacuum desorption at high temperature is used to extract the HTO collected in the absorption and conversion traps. Tritium analysis is carried out using liquid scintillation spectrometry or gas proportional counting. The sampler is equipped with built-in safety systems and can operate in remote places. Refs, figs and tabs.

6499 (INIS-mf–13387, pp. 833-847) **Radon problem in uranium industry.** Khan, A.H. (BARC Health Physics Unit, Jaduguda (India)); Raghavayya, M. Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences. 1991. [653] (CONF-8912172–: International symposium on uranium technology, Bombay (India), 13 Dec 1989). In *Proceedings of the international symposium on uranium technology [held at Bombay during 13-15 Dec 1989]. V. 2.* Order Number DE93608801. Source: OSTI; NTIS (US Sales Only); INIS.

Radon emission is invariably associated with the mining and processing of uranium ores. Radon (sup(222)Rn) enters mine atmosphere through diffusion from exposed ore body, fractures and fissures in the rocks and is also brought in by ground water. Being the progenitor of a series of short lived radioisotopes it contributes over 70% of the radiation dose to mine workers and thus accounts for nearly 30% of the total radiation doses received by workers in the whole nuclear industry. This paper summarises the data on radon emanation from the ore body, backfilled sands and mine water. Radon and its progeny concentrations in different haulage levels and stopes of the Jaduguda uranium mine are presented to emphasise the need for a well planned ventilation system to control radiation exposure of miners. Results of radon monitoring from a few exploratory uranium mines are included to indicate the need for a good ventilation system from inception of the mining operations. Relative contribution of mine exhaust and tailings surfaces to the environmental radon are also given. Some instruments developed locally for monitoring of radon and its progeny in mines and in the environment are briefly described to indicate the progress made in this field. (author). 17 refs., 2 figs., 6 tabs.

6500 (IVL-B–1052) **Nitrogen oxides in Swedish urban areas - exposure status.** Steen, B.; Cooper, D. Swedish Environmental Research Inst., Goeteborg (Sweden). Apr 1992. 24p. (In Swedish). Order Number DE93753075. Source: OSTI; NTIS.

An estimate of the Swedish population's exposure to urban NO_2 levels has been carried out. The NO_2 concentrations for different municipal districts in 18 Swedish towns/cities were calculated based on modelled results from collected emission inventories. In addition, the contribution of the most significant traffic emissions close to major roads in Gothenburg were modelled and evaluated. The populations subjected to excessive NO_2 concentrations relative to the present national guideline (110 $\mu g/m^3$) and three other cases for short-term exposure (98 per centile of 1 hour averages) were determined using day-time population statistics. The results indicated that ca 26% and 13% of the residents of Gothenburg and Stockholm respectively, are exposed to NO_2 levels exceeding the present national guideline. In the smaller towns virtually no excessive exposure was noted except in the cases of reducing the present limit of 110 $\mu g/m^3$. A rough estimate for the total population of Sweden suggests that ca 3% of the population are subject to ambient NO_2 concentrations greater than the present national guideline for short-term exposure. Due to the limitations of this study and uncertainties coupled with much of the input data, several assumptions and consequently error sources have been introduced. The calculated results are however in line with other international estimates of excessive short-term exposure e.g. UNEP/GEMS. (12 refs., 5 figs., 5 tabs.).

6501 (IVL-B–1055) **Mapping deposition of sulphur, nitrogen and base cations in the Nordic countries.** Loevblad, G. (Swedish Environmental Research Inst., Gothenburg (Sweden)); Andersen, B.; Joffre, S.; Reissell, A.; Pedersen, U.; Hovmand, M. Swedish Environmental Research Inst., Goeteborg (Sweden). Jun 1992. 33p. Order Number DE93753074. Source: OSTI; NTIS.

The main purpose of this joint Nordic effort was to map total deposition using available data from measurements of precipitation, ambient air quality and throughfall. Data from national networks were combined in order to avoid discontinuities along the national borders. The deposition of sulphur, nitrogen and base cations were estimated using monitoring results on wet deposition, throughfall, air pollution concentrations and literature data on nitrogen deposition velocities. Wet deposition data formed the basis of the mapping procedure. In addition to the wet deposition, dry deposition is calculated from air pollution concentrations and deposition velocities (for nitrogen) or deposition factors derived from throughfall measurements (for sulphur). The dry deposition of base cations were estimated as a factor derived from the throughfall to wet deposition ratio for sodium. The throughfall results used for deriving

deposition factors are the Scandinavian results for sulphur. The deposition to forest ecosystems was produced in order to compare it to critical loads for forest soils and to make exceedance maps for the sensitive forest ecosystems. The results were also compared with results from atmospheric dispersion and deposition models, using the integrated deposition over all types of areas within the Environmental Monitoring and Evaluation Programme (EMEP) grid squares. (35 refs., 5 tabs., 16 figs.).

6502 (JAERI-M–92-102) **High performance dispersion model PHYSIC.** Yamazawa, Hiromi (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment). Japan Atomic Energy Research Inst., Tokyo (Japan). Jul 1992. 59p. (In Japanese). Order Number DE93753303. Source: OSTI; NTIS; INIS.

The description and usage of the dispersion calculation model PHYSIC were summarized. The model was developed in the study of developing high performance SPEEDI with the purpose of introducing meteorological forecast function into the environmental emergency response system. PHYSIC consists of two parts, the three-dimensional meteorological model and the dispersion model. The former comprises primitive equations with Boussinesq approximation, which are solved by a finite difference method. The latter employs a particle dispersion method. PHYSIC can be used to evaluate the meteorological condition as well as the dispersion from a point source located in a complex terrain. The spatial and temporal scales of the model are 10 to 1000 km horizontally, 1 to 10 km vertically and 1 hour to 1 day, respectively. (author).

6503 (Juel–2614) **International greenhouse gas verification. No. 1. Analysis of databases on climate-relevant emissions in the Federal Republic of Germany.** Fritsche, U. (Oeko-Inst. e.V., Berlin (Germany)); Matthes, F.C. Forschungszentrum Juelich GmbH (Germany). Programmgruppe Technologiefolgenforschung; Bundesministerium fuer Forschung und Technologie, Bonn (Germany). May 1992. 100p. (In German). Contract BMFT ET9188A. Order Number DE93744901. Source: OSTI; NTIS (US Sales Only).

One of the goals of the international discussion on climate-relevant frame gases is the drafting of a consistent database and of methodological agreements for national stocktaking of greenhouse gases. A number of studies on greenhouse gases have been published in Germany, but so far there has been no summary and no comparative evaluation. For this reason, the Oeko-Institut was asked to draw up a review of the greenhouse gases databases available in Germany and to discuss the assumptions, methods and data background on which they are based. It was found that in spite of detailed official statistics and a large volume of data on greenhouse gas emissions, verificable data on greenhouse gas emissions are available - and will continue to be so in the near future only for CO_2 emissions from energy conversion processes. (orig./KW).

6504 (KFK–5076) **Prediction of advected smog for the SO_2-early warning-system of the Federal Environmental Agency of Germany (Umweltbundesamt).** Braeutigam, K.R.; Sardemann, G.; Brandl, V.; Kupsch, C.; Matzerath Boccaccini, C. Kernforschungszentrum Karlsruhe GmbH (Germany). Abt. fuer Angewandte Systemanalyse; Umweltbundesamt, Berlin (Germany). Aug 1992. 155p. (In German). Contract UFOPLAN 10402591. Order Number DE93750688. Source: OSTI; NTIS (US Sales Only).

The dispersion model SMOVO developed for use in the smog-early-warning-system of the Umweltbundesamt is described in detail. SMOVO uses weather forecast data of the German Weather Service (BKF-/BKN-model) and a SO_2-emission inventory which covers the area of Germany, CSFR, Poland, BENELUX, France and Great Britain. The model has been run on a preliminary routine base on the computer facilities of the German Weather Service. Each day of the winter months october to march of the years 1989/90 and 1990/91 3-hourly SO_2-concentration values were calculated for a forecast range of 2 days on grid elements of 1^0 longitude * $1/2^0$ latitude. The calculated SO_2 concentrations were compared with measured concentration values compiled by the smog-early-warning-system. Additional calculations were made for episodes of high SO_2-concentrations in the years 1985 and 1987. In general, the dispersion model allows quite adequate forecasts of SO_2 concentration levels and the beginning and end of high concentration episodes. Main differences are caused by different regional distributions of calculated and measured SO_2 concentration values. The quality of smog forecast is enhanced by combining the calculated SO_2 concentration fields with additional weather information and measured SO_2-concentrations. An additional program CYTRA10 to calculate backward-trajectories has been developed as an aid to visualize the transport of SO_2. (orig.) With 57 refs., 9 tabs., 50 figs.

6505 (KFK-PEF–80-Vol.2) **7. status colloquium of the PEF project on March 5-7, 1991 at Karlsruhe Nuclear Research Center.** Horsch, F.; Filby, W.G.; Fund, N.; Gross, S.; Hanisch, B.; Reinhardt, W.; Seidel, A. (comps.). Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. 458p. (In German). (CONF-9103265–: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). Order Number DE93744819. Source: OSTI; NTIS (US Sales Only).

During the 5-7th of March 1991 the Seventh Status Report of the Project 'European Research Centre for Air Pollution Control Measures' took place at the Nuclear Research Center Karlsruhe. Progress reports on the following topics investigation into damage and elucidation of the causes and effects of forest decline, air pollution effects on human health, research into atmospheric dispersion, conversion and deposition of airborne pollutants, development and optimization of industrial-technical processes to reduce or avoid emissions, providing instruments and making recommendations to the industrial and political sectors were presented. (orig.).

6506 (KFK-PEF–80-Vol.2, pp. 387-400) **Characterization of anthropogenic dusts in ambient air at typical sites in Baden-Wuerttemberg, distribution with respect to time and space of selected toxic and cancerogenic dust components.** Marfels, H. (Fraunhofer-Inst. fuer Umweltchemie und Oekotoxikologie, Schmallenberg-Grafschaft (Germany)); Iburg, J.; Fritsche, U.; Koenig, J.; Balfanz, E. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7. status colloquium of the PEF project on March 5-7, 1991 at Karlsruhe Nuclear Research Center.* 458p. Order Number DE93744819. Source: OSTI; NTIS (US Sales Only).

In 1990 the work in the inorganic sector was focussed on Factor Analyses to determine particle sources; furthermore special investigations (carbon analysis, single particle analysis) were performed. The heavy metals Pb, Cd, and Ni in the dust could be attributed to industrial emission sources and to traffic. During this period among the regularly determined organic dust components especially the group of nitro polycyclic aromatic hydrocarbons is accentuated. For 1-nitronaphthalene the maximum was observed during the summer months, while the maximum for 2-nitrofluoroanthene, analogous to PAH, appeared in winter. (orig.).

6507 (KFK-PEF–80-Vol.2, pp. 575-588) **Emission data for VOC and CO with a high temporal and spatial resolution for the State of Baden-Wuerttemberg.** Obermeier, A. (Inst. fuer Energiewirtschaft und Rationelle Energieversorgung, Stuttgart Univ. (Germany)); Friedrich, R.; John, C.; Voss, A. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7. status colloquium of the PEF project on March 5-7, 1991 at Karlsruhe Nuclear Research Center.* 458p. Order Number DE93744819. Source: OSTI; NTIS (US Sales Only).

In the frame of a research project entitled 'Temporal Variations and Spatial Distribution of Emissions of Volatile Organic Compounds and Carbon Monoxide in the State of Baden-Wuerttemberg', which has been finished already, methods have been developed resp. modified that can be used to assess hourly

emissions of VOC and CO for the reference year 1985 from selected source categories for each community resp. for grid elements of different size in the State of Baden-Wuerttemberg. VOC-emissions have been subdivided into 17 classes. Yearly emissions of VOC and CO in 1985 as well as emission data with a high spatial and temporal resolution for one week in January and one week in September are illustrated and discussed in this paper. (orig.).

6508 (KFK-PEF–80-Vol.2, pp. 589-601) **Distinguishing cloud droplet residues and particles of the interstitial aerosol by laser microprobe mass spectrometry and bulk analytical techniques.** Gieray, R. (Inst. fuer Physik, Hohenheim Univ., Stuttgart (Germany)); Wieser, P.; Schreiber, H. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7. status colloquium of the PEF project on March 5-7, 1991 at Karlsruhe Nuclear Research Center.* 458p. Order Number DE93744819. Source: OSTI; NTIS (US Sales Only).

To study aerosol discrimination resulting from orographic cloud formation and in-cloud scavenging processes cloud droplet residues and particles of the interstitial aerosol are compared using laser microprobe mass spectrometry and bulk analytical techniques. To separate the liquid phase from the gaseous and particulate material of the interistitial aerosol a counterflow virtual impactor has been constructed. It was found e.g. that large particles of the interstitial aerosol are residues of (non-activated) relatively small droplets. In the aerodynamic size range between 0.18 μm and 0.65 μm in diameter the particulate matter mainly consists of (hydrophobic) carbonaceous material. The small particle fraction (diameter about 0.1 μm) was formed by non-activated sulfate nuclei. Sea salt, carbonate, and silicate species are involved in large cloud droplet formation. As the main components cloud droplet residues contain sulfates and nitrates internally mixed with trace substances of primary aerosols. The size distribution of cloud droplet residues typically shows the maximum in the size range between 0.35 μm and 1.2 μm. (orig.).

6509 (KFK-PEF–80-Vol.2, pp. 603-612) **Characterization of an orographic cloud using a dual approach: Single particle and bulk analysis.** Gieray, R. (Inst. fuer Physik, Hohenheim Univ., Stuttgart (Germany)); Wieser, P.; Lammel, G.; Metzig, G. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7. status colloquium of the PEF project on March 5-7, 1991 at Karlsruhe Nuclear Research Center.* 458p. Order Number DE93744819. Source: OSTI; NTIS (US Sales Only).

In order to determine the trace substances, their distribution and the extent of homogeneity of both the aqueous phase and the particle phase of an orographic cloud, a novel approach was used. Particles and droplets of different size exhibited different chemical composition. All trace substances analysed have been found to be higher concentrated within those particles exceeding 2 μm of size (aerodynamic equivalent diameter), when compared to those droplets exceeding 15 μm of size. In particular, mineral particles have been incorporated into large droplets. The ions ammonium, sulfate, and nitrate have been found partially in internal mixture: Ammonium and sulfate ions dominated the particle size from 1 to 5 μm and have been mixed with carbon internally in the fine particle mode, whereas nitrate was more localized with large droplets. (orig.).

6510 (KFK-PEF–80-Vol.2, pp. 613-622) **Measurement of the dry deposition rates on trees by using the natural radioactivity as a tracer.** Schreiber, H. (Inst. fuer Physik, Hohenheim Univ., Stuttgart (Germany)); Gunsilius, H. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7. status colloquium of the PEF project on March 5-7, 1991 at Karlsruhe Nuclear Research Center.* 458p. Order Number DE93744819. Source: OSTI; NTIS (US Sales Only).

Gaseous and particle bound materials are removed from the atmosphere by wet and dry deposition. The radioactive daughters of radon emanation can be used as a tracer. Numerous measurements of the fluxes towards leaves, needles and surrogate surfaces have been accomplished. To gain quantitative results for different compounds we need their size distribution in the airborne state. High volume impactors and a recently constructed diffusion battery are suitable devices. The wind speed has been shown to have a dominant influence on the deposition velocity. The calculated input fluxes for situations with high concentrations of particulate sulphur were rather small compared to the contribution during moderate or high wind speed conditions. (orig.).

6511 (KFK-PEF–80-Vol.2, pp. 623-634) **Development and application of a quasi-continuously working system for measuring the immission of acid air pollutants like HCl, NO_2 and SO_2 using a dry absorber tube.** Creutznacher, H. (Inst. fuer Chemische Technik, Karlsruhe Univ. (T.H.) (Germany)); Weisweiler, W. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7. status colloquium of the PEF project on March 5-7, 1991 at Karlsruhe Nuclear Research Center.* 458p. Order Number DE93744819. Source: OSTI; NTIS (US Sales Only).

Main objective of this study during the report time 1990 is found to be the testing of different absorption materials for the simultaneous determination of acid gaseous pollutants like HCl, NO_2 and SO_2. These materials - so-called active collectors - were examined in laboratory-scale experiments using gas mixtures with various concentrations of the pollutants which should be chemisorbed by the active collectors. After evaluation of the active collector and ion chromatographical analysis of the solutions informations about the absorption/desorption rate are obtained. In all cases absorption materials were tested on which amino-functional groups are deposited by chemical reaction. The amino-groups act as reactive sites for the chemisorption of the acid gases. It can be observed that all tested materials are suitable for the measurement of HCl. Additionally some types of absorption materials are effective for the simultaneous absorption of HCl and SO_2, whereas the measurement of NO_2 has to be optimised. (orig.).

6512 (KFK-PEF–80-Vol.2, pp. 635-647) **Efficient strategies to reduce concentration levels. Pt. 2. Calculation of the emitter-receptor relationship for given emission rates and meteorological diffusion conditions.** Vogel, H. (Inst. fuer Meteorologie und Klimaforschung, Karlsruhe Univ. (Germany)); Fiedler, F. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7. status colloquium of the PEF project on March 5-7, 1991 at Karlsruhe Nuclear Research Center.* 458p. Order Number DE93744819. Source: OSTI; NTIS (US Sales Only).

By using a modeling system which describes atmospheric flow, turbulent diffusion and chemical transformations the effect of emission changes upon temporal and spatial distributions of concentrations in the regional scale will be investigated. Numerical simulations of typical meteorological and emission conditions are carried out over inhomogeneous terrain in order to determine average concentration pattern. The formation of ozone in an urban plume is investigated. Therefore the meteorological variables are calculated under the preliminary assumption of horizontal homogeneous terrain. The results show the importance of the vertical diffusion process and the chemical reactive processes for the daily cycle of the near surface ozone concentration. Especially in case

of reduced incoming solar radiation the transport is the dominant process. (orig.).

6513 (KFK-PEF–80-Vol.2, pp. 649-658) **Smog chamber investigation of the photochemical conversion and formation of air pollutants from NO_x, hydrocarbons and sulphur dioxide.** Zetzsch, C. (Fraunhofer-Inst. fuer Toxikologie und Aerosolforschung, Hannover (Germany)); Krueger, H.U.; Palm, W.U.; Scheer, V.; Nolting, F. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7. status colloquium of the PEF project on March 5-7, 1991 at Karlsruhe Nuclear Research Center.* 458p. Order Number DE93744819. Source: OSTI; NTIS (US Sales Only).

Since the funding by the PEF of the work of the Fraunhofer-Institute at Hanover ceased in June 1990, an overview on the results from the three consecutive projects is given here. Furthermore, model calculations and experimental smog chamber simulations on the photochemical behaviour of forestal air, performed during the most recent project, are reported. The model calculations and the experiments agree in that the ozone maxima appear earlier with increasingly exaggerated concentrations of the terpenes. On the other hand, the presence of the aromatic appears to have the biggest contribution to ozone formation. This impact is expected to increase in the near future due to the present trend of emissions related to traffic. (orig.).

6514 (KFK-PEF–80-Vol.2, pp. 659-667) **Measurement of fog and cloud water constituents - results of the Le Donon campaigns.** Lammel, G. (Kernforschungszentrum Karlsruhe GmbH (Germany). Lab. fuer Aerosolphysik und Filtertechnik 1); Metzig, G. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7. status colloquium of the PEF project on March 5-7, 1991 at Karlsruhe Nuclear Research Center.* 458p. Order Number DE93744819. Source: OSTI; NTIS (US Sales Only).

An orographic cloud in the subalpine region was characterized physically and chemically. Different sampling techniques and a complete set of chemical-analytical methods were used. The advected air to the site was influenced anthropogeneally. High acid contents were analysed in liquid water samples and in the particles water soluble fraction. The most important production of acidity was by sulfate and nitrate. In average, organic acids contributed about 10% to the free acid. Sulphur (IV) compounds were found in the liquid phase. There contribution to all sulphur compounds was ten percent in average. A different phase behaviour of some trace substances was found. Nitrate was more effectively incorporated into droplets than ammonium and sulfate. Similar observations were made for some heavy metals too. The liquid phase constituents can be explained essentially by incorporation of particles and trace gases (in particular nitric acid). The presence of sulphur (IV) in the liquid phase indicates, that SO_2 was strongly contributed to the acid formation within the droplets. A discrimination of the contributions to the acidity formation processes, such as chemical and microphysical processes as well as advection was not possible. (orig.).

6515 (KFK-PEF–80-Vol.2, pp. 669-675) **Trace substance deposition into coniferous forests by fog interception in high elevations of Black Forest.** Winkler, P. (Deutscher Wetterdienst, Hamburg (Germany). Meteorologisches Observatorium). Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7. status colloquium of the PEF project on March 5-7, 1991 at Karlsruhe Nuclear Research Center.* 458p. Order Number DE93744819. Source: OSTI; NTIS (US Sales Only).

The deposition of trace substances into coniferous forests by fog interception contributes appreciable amounts to total deposition which can exceed the wet deposition in high elevations. It is the aim of this project, to assess the deposition by fog interception by means of one dimensional cloud deposition model. This model uses observed meteorological parameters as input like wind velocity and liquid water content of clouds as well as data on trace substance concentrations in cloud water samples. At the meteorological observing station on the Feldberg a measuring station was installed for routinely recording the liquid water content (PVM-100) and for collecting fog resp. cloud water samples in order to determine dissolved substances. In a first study the average frequency of a given height to be in clouds has been derived from the ceiling observations. A typical yearly cycle with maximal frequencies in fall and winter is shown. (orig.).

6516 (KFK-PEF–80-Vol.2, pp. 733-743) **Development of cleanable HEPA filters - experimentals and preliminary results.** Leibold, H. (Kernforschungszentrum Karlsruhe GmbH (Germany). Lab. fuer Aerosolphysik und Filtertechnik 1); Wilhelm, J.G. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7. status colloquium of the PEF project on March 5-7, 1991 at Karlsruhe Nuclear Research Center.* 458p. Order Number DE93744819. Source: OSTI; NTIS (US Sales Only).

Fine particle dusts with diameters less than about 2 μm, often emitted from high temperature industrial processes, cannot be sufficiently well removed from gas streams using current methods. Frequently concentrated in this small size range are heavy metals, the emission of which poses a growing environmental threat in the form of soil contamination. Current HEPA filter technology, via removal efficiencies for submicron particles some of three orders of magnitude above those of bag filters or electrostatic precipitators, offers the potential for practically eliminating fine particle emissions. A cost effective means of high efficiency gas cleaning, with total operating expenses comparable to those of conventional methods for larger particles, is offered by the development of cleanable HEPA filter units. The laboratory test rig and instrumentation for experimental investigations into the recleanability of HEPA filter media with respect to particulates in the size range of 0,05-2 μm are described. Preliminary results for cleaning cycles involving reverse flow pulsing of media samples are illustrated by the variation of pressure drop with time. The results of mathematically modelling the velocity and static pressure distributions along a channel of triangular cross section with one permeable wall during steady-state reverse flow conditions are discussed for various degrees of dust loading. Also described are the set-up, instrumentation and data acquisition for three pilot systems with recleanable filter units, installed for field testing in parallel to existing industrial gas cleaning systems. (orig.).

6517 (KFK-PEF–80-Vol.2, pp. 745-755) **Back-corona characteristics and precipitation efficiency of a tube-type electrostatic precipitator at pulsed operation.** Hinderer, A. (Inst. fuer Elektroenergiesysteme und Hochspannungstechnik, Karlsruhe Univ. (T.H.) (Germany)); Schwab, A.J. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7. status colloquium of the PEF project on March 5-7, 1991 at Karlsruhe Nuclear Research Center.* 458p. Order Number DE93744819. Source: OSTI; NTIS (US Sales Only).

Back corona in electrostatic precipitators is caused by excessive field strength in the dust layer. An analytical expression for the electric field strength in the precipitated dust layer of a tube-type electrostatic precipitator at pulsed operation is presented. It is demonstrated that the maximum field strength in the dust layer can be evaluated considering the pulse parameters duration, frequency and amplitude of the pulses, further, dust resistivity, filter current

and DC bias. These values can be measured during precipitator operation and, therefore, allow monitoring and controlling. The back-corona characteristics of a tubular electrostatic precipitator with a deposited dust layer were measured for impulses of a duration of 0.1 ms, 4 ms, and 10 ms with different pulse repetition rates, dust resistivities and corona electrodes. Pulse durations of 0.1 ms and 4 ms entail largely similar back-corona characteristics, but short pulses allow higher filter voltages. At 10-ms pulses and a low pulse repetition rate, back corona started later, while the filter voltage attained was comparatively low. Measurements of precipitation efficiency at pulsed energization and low-ohmic dust at identical precipitation performance and filter voltage show that filter current and power were halved for 0.1-ms pulses. For very high-ohmic dusts and DC energization a precipitation maximum was found which can be enhanced by pulsed energization. Particularly short impulses exhibit an additional stabilizing effect on the filter operation. (orig.).

6518 (KFK-PEF–80-Vol.2, pp. 781-791) **Studies in thermodynamics and kinetics of the absorption of halogenated hydrocarbons relevant to environment.** Weisweiler, W. (Inst. fuer Chemische Technik, Karlsruhe Univ. (T.H.) (Germany)); Eidam, K.; Kremar, W. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7. status colloquium of the PEF project on March 5-7, 1991 at Karlsruhe Nuclear Research Center.* 458p. Order Number DE93744819. Source: OSTI; NTIS (US Sales Only).

The aim of the whole research project is found to be the optimization of waste gas cleaning technologies to reduce gaseous organic emissions, the so-called volatile organic compounds (VOC) on the basis of a absorption process. Various absorption media were chosen because of their physical properties, the most important being a very low vapor pressure and a low viscosity as well. The study should yield in a compilation of measured solubility data of various volatile organic compounds in different absorption media. These data are representative for a decision about a potential technical relevance. In addition, with the aid of that solubility data it is possible to calculate the dimensions of absorption towers for waste gas cleaning processes more exactly. (orig.).

6519 (KFK-PEF–80-Vol.2, pp. 793-805) **Development and testing of high-efficiency biofilters.** Bardtke, D. (Inst. fuer Siedlungswasserbau, Wasserguete- und Abfallwirtschaft, Stuttgart Univ. (Germany)); Fischer, K.; Sabo, F. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7. status colloquium of the PEF project on March 5-7, 1991 at Karlsruhe Nuclear Research Center.* 458p. Order Number DE93744819. Source: OSTI; NTIS (US Sales Only).

Till now the best experiences were made with mixtures of burned and crushed clay and compost materials. The use of this mixture increases the porosity of the filter bed and decreases the pressure loss (this is a very important point of view using higher filter beds), further the water absorption capacity and the retention time are increasing too. Furtheron this new material mixture has a very stable structure even during long-time experiments. The current tests are concerning the work with the mentioned mixture in filter beds with a hight of about 2 m. The first results have shown that the increase in pressure loss is not much higher than in compost beds (fine compost) half as high. (orig.).

6520 (KFK-PEF–80-Vol.2, pp. 715-731) **Optimization of the separation of particles at high temperatures and simultaneous sorption of gases in a granular bed filter - experimental investigations in a secondary aluminium plant.** Peukert, W. (Inst. fuer Mechanische Verfahrenstechnik und Mechanik, Karlsruhe Univ. (T.H.) (Germany)); Loeffler, F. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7. status colloquium of the PEF project on March 5-7, 1991 at Karlsruhe Nuclear Research Center.* 458p. Order Number DE93744819. Source: OSTI; NTIS (US Sales Only).

Starting from the emissions of the secondary aluminium plant in Stockach, a concept for flue-gas cleaning with granular bed filters has been developed. The process provides two independently regenerated granular beds, separating the solids and the gases, respectively. The particles are collected in the first fixed bed using fine collectors in the size range below 0,5 mm with low filter face velocities (u_0 <0,25 m/s). In the second stage, the sorption process of the waste gases is realized with CaO- or $NaHCO_3$-pellets. Here, a countercurrent device is favorable. The supply of $NaHCO_3$ enables the recovery of the reaction products thus minimizing the residues. The proposed concept was verified with the aid of a test-rig, which was installed in the secondary aluminium plant. The emission standards were easily satisfied. Hence, it is possible to use the heat content of the flue-gases for the operation of a cristallization unit. (orig.).

6521 (KFK-PEF–80-Vol.2, pp. 807-817) **Development of a decision support system for emission reduction and emission control technologies.** Rentz, O. (Inst. fuer Industriebetriebslehre und Industrielle Produktion (IIP), Karlsruhe Univ. (T.H.) (Germany)); Hackenberg, D.; Hillenbrand, R. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7. status colloquium of the PEF project on March 5-7, 1991 at Karlsruhe Nuclear Research Center.* 458p. Order Number DE93744819. Source: OSTI; NTIS (US Sales Only).

Within the framework of this project 'Information System for Environmental Technologies - Environmental Technology Data Bank', which has been financially supported by the PEF, the test data bank TEMITEC has been developed, which describes the state of the art especially operating experience regarding emission reduction techniques in small combustion units. Using this as a basis, the concept for a system for assisting descision makers in the evaluation and selection of emission reduction and emission control techniques is developed. Emphasis of the research efforts performed up to now was on the analysis of the decision process and the relevant techno-economic field, which states the framework of the system. By this a pilot system was implemented, which was integrated in the concept of the information system TEMITEC. Further the basis for the implementation is a personal computer using the operating system MS-DOS. This project will be carried out in cooperation with a group of test users and the work group 'Flue Gas Cleaning Data Bank (DABARA)' under the overall control of the Ministry of Environment from the state Baden-Wuerttemberg. (orig.).

6522 (KFK-PEF–80-Vol.2, pp. 819-829) **Efficient strategies of reduction in immissions. Pt. 1. Calculation of emission scenarios and assessment of immissions.** Friedrich, R. (Inst. fuer Energiewirtschaft und Rationelle Energieanwendung (IER), Stuttgart Univ. (Germany)); Berner, P.; John, C.; Obermeier, A.; Seier, J.; Voss, A. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7. status colloquium of the PEF project on March 5-7, 1991 at Karlsruhe Nuclear Research Center.* 458p. Order Number DE93744819. Source: OSTI; NTIS (US Sales Only).

The aim of a rational air pollution control policy is to avoid destructive impacts on the environment by reducing the concentration of air pollutants. In this project strategies of reduction in immissions, which efficiently diminish the concentration of air pollutants (especially O_3, VOC and NO_x) in the state of Baden-Wuerttemberg, will be identified. In a first step, hourly emissions of

SO_2, NO_x, VOC and CO are calculated by the IER with a high spatial resolution for selected periods and different strategies of reduction in emissions. At the Institute of Meteorology and Climate Research in Karlsruhe immission data will be calculated using the emission data as input for atmospheric diffusion and chemical conversion models. Finally the IER will be concerned with the assessment of the immission data. The assessment covers the reduction in peak values and typical average values of immissions, distinguishing between areas with low or high immission concentrations. In the present report working steps are introduced and discussed which are carried out at the IER. (orig.).

6523 (KFK-PEF–81) **7th status colloquium of PEF on March 5 to 7, 1991 at Karlsruhe Nuclear Research Center. Summarizing reviews of the project management.** Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. 93p. (In German). (CONF-9103265–: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). Order Number DE93750611. Source: OSTI; NTIS (US Sales Only).

This is a complete retrospect on the essential results of the PEF (Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung) through 1991. The focus of interest is on economic and technical emission reduction measures. The following topics are handled: Instruments and recommendations for the economic and political area; Economic and technical processes for reduction and/or avoidance of emissions; Atmospheric dispersion, conversion and deposition of airborne pollutants; Air impurities and respiratory tract diseases; Registration and analysis of effects of airborne pollutants on forest trees; Comparative evaluation as compared to other possible causes for the novel forest diseases; Actions{Effect} of air pollutants to the soil. (UWA).

6524 (KY/YMP-MON–1/1992) **Energy consumption and emissions of the internal traffic in Finland.** Toivanen, S. Kuopio Univ. (Finland). Dept. of Environmental Sciences. 1992. 158p. (In Finnish). Order Number DE93752938. Source: OSTI; NTIS.

The aim of this study, based on literature and statistics, has been to review the energy consumption and emission of air impurities on internal domestic traffic in Finland, and to compare the energy consumptions and emissions based on transportation unit. The other aim of the research has been to estimate the future development of Finnish internal traffic from the point of view of environmental protection and sustainable development. The different traffic systems reviewed are road traffic, railway traffic, domestic waterborne traffic (excluding boating), domestic air traffic and briefly also the agricultural and forestry related traffic (farm tractors, harvesters and near transportation of forestry). Compared with other ways of traffic, the road traffic has a superior position whether it is compared with others ways of traffic based on person or goods transport, energy consumption or emissions. The increase of the road traffic has also been rapid during the last few years.

6525 (LA-UR–92-2919) **Mexico City air quality: Progress of an international collaborative project to define air quality management options.** Streit, G.E. Los Alamos National Lab., NM (United States). [1992]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9210178–1: Supercities international conference on environmental quality and sustainable development, San Francisco, CA (United States), 25-30 Oct 1992). Order Number DE93000798. Source: OSTI; NTIS; INIS; GPO Dep.

Mexico City, faces a severe air pollution problem due to a combination of circumstances. The city is in a high mountain basin at a subtropical latitude. The basin setting inhibits dispersion of pollution and contributes to frequent wintertime thermal inversions which further trap pollutants near the surface. The elevation and latitude combine to provide plentiful sunshine which, in comparison to more northern latitudes, is enhanced in the UV radiation which drives atmospheric photochemistry to produce secondary pollutants such as ozone. The Area Metropolitana de la Ciudad de Mexico AMCW is defined to include the 16 delegations of the Federal District (D.F.) and 17 highly urbanized municipalities in the State of Mexico which border the D.F. The 1990 census (XI Censo General de Poblacion y Vivienda de 1990) records that slightly over 15 million people live in the AMCM. There are numerous other nearby communities which are in the airshed region of Mexico City, but which are not included in the definition and population of the AMCM. The Mexico City Air Quality Research Initiative is one project that is examining the complex relationship between air pollution, economic growth, societal values, and air quality management policies. The project utilizes a systems approach including computer modeling, comprehensive measurement studies of Mexico City's air pollutants, environmental chemical reaction studies and socioeconomic analysis. Los Alamos National Laboratory (USA) and the Mexican Petroleum Institute are the designated lead institutions.

6526 (LBL–32950) **The reduction of NO_x by HNCO.** Brown, N.J.; Garay, J. Lawrence Berkeley Lab., CA (United States). Oct 1992. 60p. Sponsored by USDOE, Washington, DC (United States); California Inst. for Energy Efficiency, Berkeley, CA (United States). DOE Contract AC03-76SF00098. (CONF-9210213–2: 1992 Combustion Institute fall meeting of the western states section, Berkeley, CA (United States), 12-13 Oct 1992). Order Number DE93002574. Source: OSTI; NTIS; INIS; GPO Dep.

A chemical mechanism for the reduction of NO_x by HNCO has been constructed to model NO_x reduction in exhausts typical of natural gas combustion with the addition of radical boosters (fuel). Variables considered were the initial concentrations of NO, NO_2, CO, O_2, CH_4, H_2, and HNCO as well as initial temperatures. The chemical model was validated by comparing results with earlier model calculations of Miller and Bowman and with the experiments of Caton and Siebers and Lyon and Cole. Agreement with experiments was satisfactory. The reduction chemistry must be preceded by thermal ignition chemistry which generates radicals. The lowest temperature for which ignition occurs is the optimum temperature for reduction and defines the beginning of the temperature window. Reduction was not achieved for the "natural gas exhaust" for a reasonable residence time. Additional H_2 added to the exhaust mixture enhanced reduction, but the addition of CO and CH_4 did not. Under some conditions the computed sensitivity coefficient for nitrogen species and temperature exhibited self-similarity. Four reaction paths were identified which controlled the fate of the NO: the conversion of NO to NO_2 via HO_2, the conversion of NO_2 to NO via reaction with H or O, the reduction of NO via NCO, and the reduction of NO from reactions with NH_i species. The relative importance of the four was determined by the initial conditions.

6527 (LBL-PUB–5351) **Draft and final Supplemental Environmental Impact Report for the proposed renewal of the contract between the United States Department of Energy and the Regents of the University of California for operation and management of the Lawrence berkeley Laboratory.** Sandia National Labs., Albuquerque, NM (United States); Fink (Ira) and Associates, Inc., Berkeley, CA (United States). Sep 1992. 581p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE93000585. Source: OSTI; NTIS; GPO Dep.

This Supplemental Environmental Impact Report (SEIR) has been prepared in conformance with the California Environmental Quality Act (CEQA) and the University of California Procedures for the Implementation of CEQA (UC Procedures) to evaluate the potential environmental impacts associated with the University of California's operation of the Lawrence Berkeley Laboratory (LBL) for the next five years. The specific project under consideration in this SEIR is the renewal of a five-year contract between the University and the United States Department of Energy (DOE) to manage and operate the Lawrence Berkeley Laboratory. As the California agency responsible for carrying out the proposed project, the University is the lead agency responsible for CEQA compliance. Environmental impacts, mitigation, and a site overview are presented.

6528 (MST-LUFT-A–96-Ed.2) **An operational procedure for mixing height estimation.** Olesen, H.R.; Jensen, A.B.; Brown, N. Miljoestyrelsen, Roskilde (Denmark). Luftforureningslab. Jun 1992. 183p. Order Number DE93752747. Source: OSTI; NTIS.

A model is described in which a mixing height is determined on an operational basis for use in, for example, meteorological dispersion models. The core of the model is a scheme for numerical

integration of the convective mising height z_i during daytime hours. The integrated forenoon z_i's are adjusted when an evident raised inversion is observed in the noon temperature profile. A mechanical mixing height proportional to the friction velocity is determined for all hours. When present, a synoptic-scale lid is further taken into consideration. An operational mixing height z_{mix} for all hours is chosen from the available canditates. A stability parameter - the Brunt-Vaisala frequency squared - is computed for the layers above z_{mix} and z_i. (au) (32 refs.).

6529 (MST-LUFT-A–122-Ed.2) **The OML meteorological preprocessor.** Olesen, H.R.; Brown, N. Miljoestyrelsen, Roskilde (Denmark). Luftforureningslab. Jun 1992. 122p. Order Number DE93752791. Source: OSTI; NTIS.

A meteorological preprocessor is described. It computes key physical parameters on an hourly operational basis for use in dispersion models. Input to the preprocessor is hourly surface measurements and twice-daily vertical profiles from, for example, radio soundings. Sensible heat flux from the surface, friction velocity and Monin-Obukhov lenght are computed. Two alternative methods used for this purpose are described: a method applying resistances at the surface, and one applying similarity profiles in the surface layer. The convective mixing height is estimated for daytime hours by numerical integration. An operational mixing height is chosen for all hours from the convective mixing height and other available candidates. A stability parameter is computed for layers above the mixing heights. (Au).

6530 (NILU-OR–32/92) **Regional and global air pollution from aircraft.** Stordal, F.; Pedersen, U. Norsk Inst. for Luftforskning, Lillestroem (Norway). Apr 1992. 38p. Order Number DE93753001. Source: OSTI; NTIS.

The regional and global air pollution problems discussed in this report are ozone formation in the troposphere, acid deposition, depletion of the stratospheric ozone layer and increasing greenhouse effect. Currently, the two most important air pollution problems related to aircraft emissions are oxidant formation and increasing greenhouse effect, in both cases mainly due to emissions of NO_x. The acid deposition from aircraft emissions is not believed to be significant on global or regional scales. Depletion of the stratospheric ozone layer is neither a problem with the current fleet of aircraft. A proposed fleet of high flying aircraft in the future may however threaten the ozone layer. 22 refs., 9 figs., 3 tabs.

6531 (NILU-OR–73/91) **Greenhouse effect and greenhouse warming potentials for CF_4 and C_2F_6.** Stordal, F.; Myhre, G. Norsk Inst. for Luftforskning, Lillestroem (Norway). Nov 1991. 16p. Order Number DE93753016. Source: OSTI; NTIS.

The report describes the greenhouse effect caused by the species CF_4 and C_2F_6 which are produced in aluminium processing. Global Warming Potential (GWP) values are calculated with a broadband infrared radiation transfer model. 14 refs., 1 fig., 3 tabs.

6532 (NILU-OR–74/91) **Greenhouse effect and greenhouse warming potential for SF_6.** Stordal, F.; Myhre, G. Norsk Inst. for Luftforskning, Lillestroem (Norway). Nov 1991. 16p. Order Number DE93753002. Source: OSTI; NTIS.

The report describes the greenhouse effect caused by the species SF_6 which is used in the magnesium industry. Global Warming Potential (GWP) values are calculated with a broad band infrared radiation transfer model. 15 refs., 1 fig., 3 tabs.

6533 (SA-PUB–3/92, pp. 13-18) **Dendrochronology and climatic history in the subarctic area of Fennoscandia.** Eronen, M. (Joensuu Univ. (Finland). Karelian Institute); Zettenberg, P. Academy of Finland, Helsinki (Finland). 1992. In *The Finnish research programme on climate change: Progress report.* 310p. Order Number DE93752870. Source: OSTI; NTIS.

SILMU Research Programme.

The main outlines of the postglacial climatic history of Fennoscandia are relatively well known on the basis of numerous investigations carried out by different methods. The changes in vegetation have been shown by pollen analysis, and the variations in the extent of the pine forests by pollen together with dated subfossil pines found beyond the present limit of pine, and further evidence of the latter kind is accumulating in the present work. A further important source of information on past climates lies in the signs of oscillations in the alpine glaciers. The general conclusion is that temperatures in Finland and northern Fennoscandia were around 2 deg C higher 6000 B.P. than at present. The details of the postglacial climatic variations are poorly known, however, because the above methods are inadequate to reveal them. The preliminary results of this SILMU project already show that basically new detailed information about past climatic variations can be obtained from the tree rings of subfossil pines in the forest limit area. The two pine chronologies described above indicate that a major change in the climatic system leading towards greater variability took place in the north around 3000 B.C. Much more palaeoclimatic information will be obtainable when the long tree-ring calendar is ready, and old wood material dated to an accuracy of one year will also make it possible to carry out many further investigations using advanced methods.

6534 (SA-PUB–3/92, pp. 19-22) **Stable carbon isotope ratios in tree rings.** Sonninen, E. (Helsinki Univ. (Finland). Dating Lab.); Jungner, H. Academy of Finland, Helsinki (Finland). 1992. In *The Finnish research programme on climate change: Progress report.* 310p. Order Number DE93752870. Source: OSTI; NTIS.

SILMU Research Programme.

The isotopic composition of atmospheric carbon dioxide (CO_2) changes due to exchange of CO_2 between the three carbon reservoirs, the atmosphere, the oceans, and the biosphere. Measurements of temporal variations in the isotopic composition can therefore be used to trace changes in the biospheric CO_2 emissions. In this study the ratio of stable carbon isotopes, $^{13}C/^{12}C$, in tree rings is measured from pines growing in Northern Finland. The goal is to use the data for evaluation of the influence of the terrestrial ecosystem as a source for atmospheric CO_2. The analyses reported here were performed from samples of a living pine tree covering about 200 years. This work is the beginning of a long term investigation using well preserved subfossil pine trunks collected from Northern Finland. Based on radiocarbon dating the ages of the trees extend back in time up to about 7000 years. Dendrochronology is now applied in order to connect the trees to a precise chronology. This material provides a good opportunity to extend the isotopic investigations several thousand years back in postglacial time in a sensitive tree limit area and through several climatic events.

6535 (SA-PUB–3/92, pp. 23-24) **1000-years dynamics of limnic ecosystems and climatic change.** Salonen, V.P. (Geological Survey of Finland, Espoo (Finland)); Merilaeinen, J.; Vuorinen, I. Academy of Finland, Helsinki (Finland). 1992. In *The Finnish research programme on climate change: Progress report.* 310p. Order Number DE93752870. Source: OSTI; NTIS.

SILMU Research Programme.

Short communication. CLIMATIC CHANGE/environmental effects; LAKES; FINLAND; AQUATIC ECOSYSTEMS; SEDIMENT-WATER INTERFACES; SEDIMENTS; RESEARCH PROGRAMS

6536 (SA-PUB–3/92, pp. 25-26) **Climate changes in Northern Europe.** Heino, R. (Finnish Meteorological Institute, Helsinki (Finland). Climatology Division). Academy of Finland, Helsinki (Finland). 1992. In *The Finnish research programme on climate change: Progress report.* 310p. Order Number DE93752870. Source: OSTI; NTIS.

SILMU Research Programme.

Short communication. CLIMATIC CHANGE/climate models; SCANDINAVIA; FORECASTING; DATA; RESEARCH PROGRAMS

6537 (SA-PUB–3/92, pp. 37-42) **Climate models and scenarios.** Fortelius, C. (Helsinki Univ. (Finland). Dept. of Meteorology); Holopainen, E.; Kaurola, J.; Ruosteenoja, K. Academy of Finland, Helsinki (Finland). 1992. In *The Finnish research programme on climate change: Progress report.* 310p. Order Number DE93752870. Source: OSTI; NTIS.

SILMU Research Programme.

Dynamical computer models of the Earth's climate are a basic tool of modern climate research. These models describe the components of the climate system (atmosphere, oceans, soil, vegetation) and their mutual interactions in terms of equations based on the laws of physics. The research in this project has dealt,

among other things, with modelling of the stationary waves in the atmosphere, issues related to the verification of climate models, an atmospheric general circulation model, and with climate scenarios for Finland.

6538 (SA-PUB–3/92, pp. 43-47) **Microclimatic models for assessing the effect of climate and land cover on evaporation.** Heikinheimo, M. (Finnish Meteorological Inst., Helsinki (Finland)); Koskela, T.; Sucksdorff, Y.; Tattari, S. Academy of Finland, Helsinki (Finland). 1992. In *The Finnish research programme on climate change: Progress report.* 310p. Order Number DE93752870. Source: OSTI; NTIS.

SILMU Research Programme.

The objective of this study is to test and develop parameterizations of varying complexity to obtain an optimal method for the calculation of areal evaporation. Comparisons will be made with the different parameterization schemes to study the sensitivity of evaporation to the critical factors. Modelled evaporation from homogeneous surfaces will be verified with direct measurements of evaporation under field conditions. The resulting model formulation will be applied for selected runoff basins taking into account the actual land surface characteristics.

6539 (SA-PUB–3/92, pp. 48-53) **The development of a soil/plant/atmosphere model.** Sucksdorff, Y. (National Board of Waters and the Environment, Helsinki (Finland). Environment Data Centre); Ikonen, J.P.; Tattari, S.; Heikinheimo, M.; Ottle, C.; Mehrez, M.B. Academy of Finland, Helsinki (Finland). 1992. In *The Finnish research programme on climate change: Progress report.* 310p. Order Number DE93752870. Source: OSTI; NTIS.

SILMU Research Programme.

Knowledge of evapotranspiration processes at different scales gives valuable information to climate change studies. It is widely known that present hydrological models do not succeed to simulate the evapotranspiration and soil moisture changes realistically at regional scale. The area-averaged hydrological and meteorological data over large drainage basins or grids is needed to improve modelling results. In mesoscale the remotely sensed data is essential as input. The method is based on the use of soil/vegetation/atmosphere model to simulate the energy fluxes as well as the water storage variations at the mesoscale. The model is able to assimilate the infrared surface temperatures measured by satellites. If the atmospheric and surface parameters are known, the energy and hydraulic budgets at the surface can be modelled. The objective of this study is to develop an operational areal surface fluxes model based on routine meteorological, hydrological and satellite data. In the early stage of the study the methods to calculate the area-averaged input data for the model is developed.

6540 (SA-PUB–3/92, pp. 54-58) **Modeling of the interactions between atmospheric aerosols, clouds and climate.** Lindfors, V. (Finnish Meteorological Inst., Helsinki (Finland). Air Quality Dept.); Damski, J.; Joffre, S.M.; Nordlund, G. Academy of Finland, Helsinki (Finland). 1992. In *The Finnish research programme on climate change: Progress report.* 310p. Order Number DE93752870. Source: OSTI; NTIS.

SILMU Research Programme.

Clouds are the main modulators of the Earth's radiative balance, and thus their role in climate change studies is of profound importance. According to recent results, clouds have a net cooling effect on the climate, but there are large variations depending on the season, the surface characteristics, and the cloud type and amount. At present, however, clouds are also one of the main sources of uncertainty in climate models. Thus it is well warranted to study the cloud processes, and the factors which control their properties. Interactions between clouds and atmospheric aerosols are of special interest, because the formation of clouds and precipitation are dependent on the number and characteristics of atmospheric cloud condensation nuclei or ice nuclei. Cloud albedo and the absorption of radiation within the cloud layer are also influenced by the incorporated aerosol particles. In addition to their effects on the climate via clouds, atmospheric aerosols have a direct radiative influence; hence they are an important contributor to the radiation budget also in cloudless regions.

6541 (SA-PUB–3/92, pp. 59-64) **Chemical and physical conversion in cold atmosphere and the effect of radiation.** Kulmala, M. (Helsinki Univ. (Finland). Dept. of Physics); Laaksonen, A.; Maekelae, J.; Korhonen, P. Academy of Finland, Helsinki (Finland). 1992. In *The Finnish research programme on climate change: Progress report.* 310p. Order Number DE93752870. Source: OSTI; NTIS.

SILMU Research Programme.

The main interest in this project is focused on formation and growth mechanisms of atmospheric aerosols and cloud droplets. Droplet formation is the result of physical and chemical processes occurring simultaneously. We are developing a dynamic aerosol model to describe the behaviour of particulate systems in the atmosphere. The model consists of submodels for chemical and photochemical conversion, nucleation, condensation/evaporation, coagulation and deposition. Besides of theoretical and numerical developments, also experimental work is done to confirm the predictions of the various submodels.

6542 (SA-PUB–3/92, pp. 65-69) **Mathematical modelling of atmospheric aerosol phenomena.** Hillamo, R. (Finnish Meteorological Inst., Helsinki (Finland)); Kerminen, V.M.; Keronen, P.; Pakkanen, T.; Vuori, M.; Mattsson, R. Academy of Finland, Helsinki (Finland). 1992. In *The Finnish research programme on climate change: Progress report.* 310p. Order Number DE93752870. Source: OSTI; NTIS.

SILMU Research Programme.

To understand the dynamics of atmospheric aerosols the different phenomena is needed to be studied theoretically and experimentally. In this project, the most common aerosol model is being utilized. The aerosol model has been developed by Fred Gelbard and John Seinfeld. The model consists of two computer programs, which simulate the dynamics of the multi-component aerosol. The first version of the code was released in 1982. The latest version of 1989 has been updated with better numerical methods and documentation, and it consists of two programs: MAEROS2 and MGA. MAEROS2 (=Multicomponent AEROSol Model) calculates aerosol compositions and mass concentration as a function of particle size and time. The processes that are incorporated are coagulation due to Brownian motion, gravity and turbulence, particle deposition due to gravitational settling, diffusion, thermophoresis and diffusiophoresis, particle growth or shrinkage due to water vapour condensation or evaporation from the particle surface, and time varying sources of particles of different sizes and chemical compositions. MGA (=Moving Grid Analysis) simulates multi-component aerosol growth by vapour condensation in a closed, thermally insulated, constant volume chamber.

6543 (SA-PUB–3/92, pp. 73-81) **On the behaviour of ozone in the free atmosphere and the Uvb radiation in the Northern Europe.** Taalas, P. (Finnish Meteorological Inst., Helsinki (Finland)); Suppen, A.; Kyroe, E. Academy of Finland, Helsinki (Finland). 1992. In *The Finnish research programme on climate change: Progress report.* 310p. Order Number DE93752870. Source: OSTI; NTIS.

SILMU Research Programme.

According to recent trend calculations the total ozone content of the stratosphere outside the tropics has decreased more during the 1980s than during the previous decade. The corrected TOMS-satellite observations for 1979-90 indicate that the decreasing trend has been strongest at high latitudes during late winter/early spring, i.e. -3,0 %/year in the latitude band 70-80 deg S and -1,5 %/year in the latitude band 60-70 deg N, respectively. The yearly mean trends have been considerably lower. It has been estimated that one percent drop in total ozone causes an increase in the intensity of uvb radiation by 2 %, which may increase skin cancer by 2-4 %. The FMI has performed meteorological balloonborne soundings in Sodankylae since 1949. These routine measurements include following meteorological parameters: temperature, relative humidity, geopotential height and wind speed and direction. These soundings are available in digitized form since 1965. The temperature time series of 30, 50, 70 and 100 hPa level at Sodankylae for 1965-88 has been studied. The errors caused by changes in radiosonde types and the radiation errors have been corrected before any calculation.

6544 (SA-PUB–3/92, pp. 82-86) **Global research of atmospheric pollutants.** Rummukainen, M. (Finnish Meteorological Inst., Helsinki (Finland)); Joffre, S. Academy of Finland, Helsinki (Finland). 1992. In *The Finnish research programme on climate change: Progress report.* 310p. Order Number DE93752870. Source: OSTI; NTIS.

SILMU Research Programme.

The Finnish Meteorological Institute (FMI) participates in SILMU by performing intensive ozone sounding campaigns at Ny Aalesund, Spitsbergen. The aim of these studies is to gain information about the magnitude and type of dynamically-induced variations in ozone during different seasons, and to search for signs of chemical ozone loss caused by pollution. Balloon-borne ozonesondes are typically capable of providing local vertical profiles from ground level to more than 30 km in altitude. As dynamical factors strongly affect ozone in the Northern Hemisphere, the observations must be interpreted in the light of hemispheric meteorological evolution. FMI is keeping this in mind and we cooperate with e.g. German and Norwegian scientists. Our studies started with the summer campaign of 1989 and continued during the next two springs. The fourth campaign will be realized with the pan-European study European Arctic Stratospheric Ozone Experiment (EASOE) during the winter of 1991/92. The field measurements have continued with a new campaign in Spitsbergen at the end of 1991. The processing of the then-achieved data has already started. In addition to the more common meteorological fields and trajectories, the calculation of potential vorticity will be possible. This will greatly enrich the interpretation. As the study will be performed in conjunction with the EASOE campaign, a wealth of concurrent observations of ozone and chemical and dynamical parameters influencing it will also be available. In addition to this further analysis of the behaviour of stratospheric ozone, the new material seems to provide possibilities to study the interaction of stratosphere and the troposphere in the so-called tropopause foldings. In this way subproject of SILMU becomes connected to the research into tropospheric ozone, addressed by SILMU.

6545 (SA-PUB–3/92, pp. 93-98) **Variations of tropospheric ozone concentrations.** Laurila, T. (Finnish Meteorological Inst., Helsinki (Finland). Air Quality Dept.); Joffre, S.M.; Laettilae, H.; Koskinen, T. Academy of Finland, Helsinki (Finland). 1992. In *The Finnish research programme on climate change: Progress report.* 310p. Order Number DE93752870. Source: OSTI; NTIS.

SILMU Research Programme.

The main scientific goals of this SILMU subproject are to elucidate the average concentrations, sources and sinks of tropospheric ozone over Finland. Moreover, the variability of ozone concentrations in connection with the meteorological conditions (transport trajectories and boundary layer structure) and the potential for episoid chemical formation and destruction will be studied. One focus of interest will be the temporal and spatial extent of ozone episodes during their build-up from precursor source regions to Finland. Short-term episodic variations are embedded in long-period (several weeks) variations. Positive episodic concentrations usually occur during southerly winds when transport is from the European precursor source areas. Occasionally, when low wind speeds and sunny weather prevail, ozone formation, indicated by concomitant ozone and PAN episodes, may take place over the study area. During the short daylight season from October to March, negative deviations of ozone concentrations from background levels of ca. 30-40 ppb are observed in polluted air masses. Both long- and short-period variations of ozone concentrations will be studied in relation to long-range transport, large-scale weather patterns and specific meteorological events. A study of the source areas of various hydrocarbons and an episodic analysis of ozone and its precursor gases will be conducted. Special emphasis will be given to the wintertime ozone measurements conducted at the new monitoring stations located in Finnish Lapland, since air chemistry in the absence of light is relatively unknown. In addition, the free tropospheric part of the ozone soundings conducted on Spitzbergen in connection with other projects of the Finnish Meteorological Institute will be analysed to study the effects of photochemistry and clouds on the formation and destruction of ozone at a remote polar site.

6546 (SA-PUB–3/92, pp. 274-279) **Structural materials.** Pyy, H. (Technical Research Centre of Finland, Espoo (Finland). Lab. of Building Materials); Rautiainen, L.; Silvennoinen, K. Academy of Finland, Helsinki (Finland). 1992. In *The Finnish research programme on climate change: Progress report.* 310p. Order Number DE93752870. Source: OSTI; NTIS.

SILMU Research Programme.

The aim of the research is to determine the effects of Finland's atmospheric impurities on the durability of metallic and mineral-aggregate-based building materials. The project is divided into three parts: Joint Nordic condition assessment methods: The research invokes determining the condition assessment methods in use in the different Nordic countries, Europe and in other countries with climatic conditions similar to those of the Nordic region and investigations on the subject currents under way. As a joint Nordic project, work is being done to produce assessment methods with uniform measurements; Assessment of amounts of material and inspection of structures: In the assessments of material quantities, the research findings on the material and age distributions of facades performed by VTT's Building Production Laboratory are being used. The structures and their condition are being examined in Helsinki. Experimental field research: In the field investigations the rate of weathering of various mineral-based facade materials in Finland as a result of atmospheric acidifying impurities is being investigated, as is its importance concerning the repair needs of facades. Test pieces at the Otaniemi and Aehtaeri test stations are used by VTT, so that for example atmospheric pollution concentrations, precipitation and rain-water composition are being continually monitored. Otaniemi provides an example of an urban climate, where the acidifying atmospheric impurity contents comprise both local emissions and those brought by long-distance transportation; Aehtaeri is a background station where only the long-distance emissions play a significant role.

6547 (SA-PUB–3/92, pp. 283-285) **Climate change and forest management alternatives.** Valsta, L. (Finnish Forest Research Institute, Helsinki (Finland)). Academy of Finland, Helsinki (Finland). 1992. In *The Finnish research programme on climate change: Progress report.* 310p. Order Number DE93752870. Source: OSTI; NTIS.

SILMU Research Programme.

In the present study, the effects of stochasticity on forest management are examined as a decision making problem. It is assumed that the objective of forest management can be expressed in a numerical form. The objective is, e.g., to maximize the expected utility. The objective can accommodate decision maker's attitude towards risk: risk taking or, usually, risk aversion. Adaptability of an optimum stand management strategy is an important factor. After a strategy is chosen, it can be altered based on observations on the forest and how often can this be done. An important question in adaptive optimization regards the information used in feedback decision rules. An adaptive optimum strategy takes into account stochastic phenomena in nature and markets, as well as the long term effects of nearby treatments. In addition to developing an optimization model, the objectives of the study are to analyze the impacts of climate change induced risks on optimum forest management. Also, the importance of variation in the goals of forest management and risk aversion are studied. The results can be compared to ordinary optimum management regimes seeking to maximize economic returns of forest management.

6548 (SA-PUB–3/92, pp. 286-289) **Prevention and alleviation of air pollution induced forest damage through soil amelioration.** Maelkoenen, E. (Finnish Forest Institute, Vantaa (Finland). Dept. of Forest Ecology); Lehto, T.; Smolander, A. Academy of Finland, Helsinki (Finland). 1992. In *The Finnish research programme on climate change: Progress report.* 310p. Order Number DE93752870. Source: OSTI; NTIS.

SILMU Research Programme.

The detrimental effects of acidic deposition on soil properties can be prevented by improving the acid neutralization capacity of the soil. Liming and ash fertilization are the only practical means of improving the neutralization capacity and of counteracting forest soil acidification on an extensive scale. In long-term experiments, liming has, as expected, decreased soil acidity and the levels of

exchangeable aluminium in the soil. At the same time liming has, however, resulted in a decrease in growth of about 10 % in Norway spruce stands. Liming has also resulted in considerable accumulation of organic matter in the humus layer, but no changes in the mineral soil. No macronutrient deficiencies have been observed, but boron deficiency has been reported in some liming experiments in Norway spruce stands. Liming has also been observed to alter the proportions of mycorrhizal species in Scots pine stands. The purpose of this study is to investigate in more detail the effects of liming on forest soils, in particular the reasons for the decreased growth of trees.

6549 (SA-PUB–3/92, pp. 298-303) **Assessment of the control strategies of greenhouse gas emissions.** Korhonen, R. (Technical Research Centre of Finland, Espoo (Finland)); Savolainen, I.; Sinisalo, J. Academy of Finland, Helsinki (Finland). 1992. In *The Finnish research programme on climate change: Progress report.* 310p. Order Number DE93752870. Source: OSTI; NTIS.

SILMU Research Programme.

The objective of this study is to develop methods, which can be used in the assessment of emission reduction strategies. The aim is to consider the strategies concerning Finland, so that these can also be compared with the global emission reduction scenarios. In the study, results of other research projects of SILMU (The Finnish Research Programme on Climate Change) will be used as well as results from international studies and assessments, e.g. those of IPCC (1990, 1991). In this study a computer model system (abbr. REFUGE, Reduction of Future Greenhouse Gas Emissions) will be developed. The system will be used to compare the emission control strategies as a function of time.

6550 (SVF–427) **Scandinavian plants with NO_x control installations.** Hjalmarsson, A.K. (AaF-Energikonsult, Stockholm (Sweden)). Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden). Apr 1992. 93p. (In Swedish). Order Number DE93753065. Source: OSTI; NTIS.

New emission standards have been introduced and existing standards tightened in Sweden, Denmark and Finland. In addition, fees on NO_x emissions were introduced in Sweden. Information was collected to obtain an overview of plants euipped with NO_x control technology and a database created. The database contains over 110 units with a total installed capacity of 30000 MW fuel input. There are plants equipped with NO_x control in Sweden, Finland as well as in Denmark. The control systems in use are either combustion measures (eg low NO_x burners, over fire air, flue gas recirculation) or flue gas treatment (SCR, SNCR). At the end of 1991, 59 plants were equipped with combustion measures (13600 MW fuel input) and 14 plants with flue gas treatment (2000 MW fuel input). In Denmark, large coal-fired boilers have been equipped with NO_x control technologies. They are mostly on coal-fired boilers in Finland too, however, a few are used there in gas turbines and one in a diesel engine. In Sweden, NO_x control measures are installed at various types of plants, including those burning different fuels from municipal waste to natural gas and using various combustion systems including boilers with burners, stokers, CFBCs, gas turbines and diesel engines. A large number of plants are equipped with NO_x control in Sweden but most units are rather small, resulting in a low total installed capacity. The NO_x reduction achieved using different measures in commercial installations varies widely. A large number of parameters affect the result such as the type of measure used, fuel, boiler design, plant size, whether the installation is new or retrofit and so on. Different combustion measures reported here result in a percentage NO_x reduction between 15 and 60% for boilers and up to 85% for gas turbines. The results from plants with SNCR vary between 35 and 50% and from plants with SCR between 65 and 95%. (au).

6551 (SVF–444) **Investigation of FTIR-spectrometry for stack gas analysis, Stage 2.** Rudling, L. (Studsvik Energy, Nykoeping (Sweden)). Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden). Jul 1992. 146p. (In Swedish). Order Number DE93753061. Source: OSTI; NTIS.

The objective of the project was to investigate the usefulness of FTIR (Fourier Transform InfraRed) absorption spectrometry for analysis of flue gas components. By means of a constructed apparatus for preparation of synthetic flue gas mixtures and a FTIR-spectrometer, infrared absorption spectrums of typical flue gas components/mixtures were recorded. A comparison of the IR-absorption spectrum of the different flue gas components, showed that only the components carbon dioxide and water had absorption at selective substance specific wave numbers. The absorption spectrum of all other flue gas components had interference from either water or carbon dioxide. However this interference could be reduced considerably by using spectrum subtraction or multivariate calibration with PLS (Partial Least Squares). Investigation of the relationship absorbency (at discrete wavenumbers) versus concentration of the different flue gas components, showed a nonlinear relationship for many substances. The limiting factor at which accuracy and sensitivity the respective flue gas components could be analysed, is in most cases depending on the water concentration in the sample. The FTIR-method can also with advantage be used for the analysis of hydrocarbons in the flue gas, eg methane and ethene. By optimization of the wave number resolution, type of radiation source, measuring path length and time and type of detector, the given detection limits can be improved considerably. In conclusion, the results of this investigation demonstrate that FTIR-absorption spectrometry is a very useful method for the analysis of different flue gas components. (au) (18 refs., 44 figs.).

6552 **The interparliamentary conference.** 1990 227p. (CONF-9004337–: Interparliamentary conference on the global environment, Washington, DC (United States), 29 Apr - 2 may 1990). Source: OSTI.

The purpose of this conference was to provide a forum for exchange of information on environmental problems with global origins and consequences. The areas of major concern included the following: global climate change; deforestation and desertification; preservation of biological diversity; safeguarding oceans and water resources; population growth; destruction of the stratospheric ozone layer; and sustainable development.

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Refer also to citation(s) 5045, 5061, 5062, 5063, 5138, 5146, 5150, 5151, 5152, 5153, 5154, 5158, 5164, 5165, 5181, 5184, 5186, 5187, 5188, 5196, 5199, 5202, 5265, 5626, 5673, 5691, 5718, 5813, 5826, 5832, 5833, 6087, 6099, 6206, 6224, 6466, 6470, 6473, 6476, 6477, 6482, 6492, 6527, 6548, 6607, 6608, 6663, 6697, 6712, 6780, 6781, 6782, 7437, 7445

6553 (BfS-ST–1/92) **Impacts of the Chernobyl reactor accident on the territories of the former German Democratic Republic in 1989.** Bundesamt fuer Strahlenschutz, Berlin (Germany). Fachbereich Strahlenschutz. Aug 1992. 72p. (In German). Order Number DE93742797. Source: OSTI; NTIS (US Sales Only); INIS.

Several reports by SAAS (the Nuclear Safety and Radiation Protection Board of the German Democratic Republic) have been discussing the effects of the Chernobyl reactor accident through 1989. Only a summary had been published for 1989 in the environmental radioactivity annual report. Institut fuer Umweltschutz had been in charge of the publication of a more detailed account as part of the 'environmental report' but the project was abandoned since the institute was wound up as of October 1990. The report under review concludes the separate German Demoncratic Republic reporting by publishing the part of the manuscript on environmental contamination caused by artificial radionuclides which gives the 1989 situation on the basis of the previous results on the effects of the Chernobyl reactor accident. The appendix lists the SAAS reports published in the past. (orig./BBR).

6554 (CONF-9111236–) **Soil and water pollution.** Arbeitsgemeinschaft der Grossforschungseinrichtungen (AGF), Bonn (Germany). 1991 86p. (In German). From AGF meeting on ground pollution and water pollution: Stocktaking - carryover - redevelopment approaches; Bonn (Germany); 28-29 Nov 1991. Order Number DE93742729. Source: OSTI; NTIS (US Sales Only).

Findings of soil and water pollution studies were presented at a conference of the Arbeitsgemeinschaft Grossfroschungseinrichtungen (AGF). The problem of soil and water pollution is past of the general subject 'analysis of environmental pollution' in environmental research. Analyses are media-dependent; apart from soil and water research, interest is also taken in atmospheric and noise research. Among the subjects discussed were those related to the ecological impact of soil and water pollution and to the remedies to be taken. (BBR).

6555 (CONF-9111236–, pp. 78-81) **Genetic strategies for improving the degradation performance of microorganisms.** Pieper, D.H. (Gesellschaft fuer Biotechnologische Forschung (GBF), Braunschweig (Germany)); Timmis, K.N. Arbeitsgemeinschaft der Grossforschungseinrichtungen (AGF), Bonn (Germany). 1991. 86p. (In German). From AGF meeting on ground pollution and water pollution: Stocktaking - carryover - redevelopment approaches; Bonn (Germany); 28-29 Nov 1991. In *Soil and water pollution.* Order Number DE93742729. Source: OSTI; NTIS (US Sales Only).

Various industrial chemicals possess structural elements or substituents that confer upon the molecule a high degree of resistance to enzymatic attack and mineralization. The evolution of new biodegradative routes to eliminate those compounds often requires different genetic events. This evolutionary process could be accelerated in different model experiments. By sequential modification of a toluene degradative pathway, i.e. broadened substrate specificity of two key enzymes and relaxed effector specificity of one regulator, a catabolic pathway for the degradation of recalcitrant 4-ethyltoluene was constructed. A novel ortho-cleavage pathway for the simultaneous degradation of chloro- and methylaromatics was constructed by the patchwork assembly of different pathway segments. (orig.).

6556 (CONF-921029–10) **White Oak Creek embayment sediment retention structure: The Oak Ridge model in action.** Van Hoesen, S.D. (Oak Ridge National Lab., TN (United States)); Kimmel, B.L.; Page, D.G.; Hudson, G.R.; Wilkerson, R.B.; Zocolla, M.; Kauschinger, J.L. Oak Ridge National Lab., TN (United States). [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Annual Department of Energy model conference on waste management and environmental restoration; Oak Ridge, TN (United States); 19-22 Oct 1992. Order Number DE93001717. Source: OSTI; NTIS; INIS; GPO Dep.

White Oak Creek is the major surface-water drainage through the Department of Energy (DOE) Oak Ridge National Laboratory (ORNL). Samples taken from the lower portion of the creek revealed high levels of Cesium-137, and lower levels of Cobalt-60 in near-surface sediment. Other contaminants present in the sediment included: lead, mercury, chromium, and PCBS. In October 1990, DOE, US Environmental Protection Agency (EPA), and Tennessee Department of Environment and Conservation (DEC) agreed to initiate a time-critical removal action in accordance with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) to prevent transport of the contaminated sediments into the Clinch River system. This paper discusses the environmental, regulatory, design, and construction issues that were encountered in conducting the remediation work.

6557 (DOE/EA–0383) **Hanford Environmental Compliance Project, Hanford Site, Richland, Washington: Environmental assessment.** USDOE, Washington, DC (United States). Mar 1992. 141p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93002207. Source: OSTI; NTIS; GPO Dep.

The purpose of the Hanford Environmental Compliance Project is to meet the goals and objectives of the RL program to ensure compliance with applicable environmental regulations. The Hanford Environmental Compliance Project would help DOE meet these goals and objectives by upgrading selected Hanford Site facilities, systems and operations capabilities that require modifications or enhancements. Existing Hanford Site effluent streams would be treated as a result of the Hanford Environmental Compliance Project. The Project focuses on four major areas of improvement: ground water monitoring, sample analysis capability, environmental upgrades to existing systems and facilities, and waste and effluent treatment, storage and disposal. The subprojects included in the Hanford Environmental Compliance Project have been selected and prioritized based on comprehensive ranking of environmental enhancement, mitigation of safety concerns, and programmatic and operational effect.

6558 (DOE/EA–0539) **Proposed sale of Parcel A2 of the Oak Ridge Reservation to the City of Oak Ridge, Tennessee: Environmental asssessment.** USDOE Oak Ridge Field Office, TN (United States). Sep 1992. 85p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93002268. Source: OSTI; NTIS; GPO Dep.

Parcel A encompasses two tracts of land owned by the US Department of Energy (DOE) on the Oak Ridge Reservation (ORR). The disposal of land was recommended by a General Services Administration 1981 land utilization survey. On June 21, 1988, 21.3 ha (52.7 acres) of land, Parcel A1, were transferred to the City of Oak Ridge. Parcel Al has since been transferred to the private sector for residential development. The City of Oak Ridge has requested acquisition of Parcel A2 for residential and industrial development. The purpose of the proposed action is to transfer Parcel A2 to the City of Oak Ridge for residential and industrial development. The need for the proposed action is for DOE to respond to the General Services Administration directive to dispose of Parcel A2 and to respond to the request by the City of Oak Ridge for its acquisition and development. The proposed sale of Parcel A2 would have no environmental impacts; however, the subsequent development by the City would affect the existing environment. It is the potential effects of the City's development of Parcel A2 that are addressed by this environmental assessment (EA). Areas of concern include land use, air quality, hydrology and water quality, wetlands and floodplains, ecological resources, and socioeconomic resources.

6559 (DOE/EA–546) **Final environmental assessment for Building 12-42F modification (Project No. GPD-121), Pantex Plant , Amarillo, Texas.** USDOE Albuquerque Field Office, Amarillo, TX (United States). Amarillo Area Office. Aug 1991. 8p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93000411. Source: OSTI; NTIS; GPO Dep.

The Environmental Assessment (EA) has been prepared pursuant to the implementing regulations to the National Environmental Policy Act (NEPA), which require federal agencies to assess the environmental impacts of a proposed action to determine whether that action requires the preparation of an Environmental Impact Statement (EIS) or if a Finding of No Significant Impact (FONSI) can be issued. NEPA requires that an EA provide an interdisciplinary review of the proposed action in order to identify possible preferable alternatives and to identify mitigative measures that will prevent environmental impacts. If it is determined that the proposed action will have unavoidable significant environmental impact, then an EIS shall be prepared. The proposed project is to modify Building 12-42F and entry into the Sandia Pantex Weapons Evaluation Test Laboratory. The modification's primary function is to provide additional space for testing and monitoring equipment to support the activities in the existing Building 12-42F. The modification will also facilitate the reconfiguration of the personnel offices, break room and conference area. The proposed Building 12-42F modification relates to the interiors of Building 12-42F and 12-42A. These buildings contain a centrifuge and associated testing and monitoring equipment. The proposed addition will encompass the existing entry into Building 12-42A. Building 12-42A will be accessed through the proposed Building 12-42F modification.

6560 (DOE/EA–0600) **Environmental Assessment for the Measurements and Controls Support Facility, Building 2033 at the Oak Ridge National Laboratory, Oak Ridge, Tennessee, US Department of Energy.** USDOE, Washington, DC (United States). Sep 1992. 19p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93002210. Source: OSTI; NTIS; GPO Dep.

The Oak Ridge National Laboratory (ORNL), which must provide space and housing for technical and support personnel of the Instrumentation and Controls (I&C) Division, is experiencing a serious space shortage. Currently, I&C personnel are housed in deteriorated facilities that cannot provide adequate working conditions. The proposed project is needed to ensure that current and future efforts by I&C are not hampered by building conditions and also to

provide adequate space for existing equipment and personnel. This paper includes a description of the proposed action, alternatives to proposed action, a description of the existing environment, the environmental impacts of the proposed action, and a summary.

6561 (DOE/EA–0791) **Sharp-tailed Grouse and Pygmy Rabbit Wildlife Mitigation Project: Final Environmental Assessment.** USDOE Bonneville Power Administration, Portland, OR (United States). Oct 1992. 44p. Sponsored by USDOE, Washington, DC (United States). (DOE/BP–1964). Order Number DE93003772. Source: OSTI; NTIS; GPO Dep.

The Proposed Action is needed to protect and enhance shrub-steppe and riparian habitat for sharp-tailed grouse (Tympanuchus phasianellus columbianus), Pygmy rabbits (Brachylagus idahoensis), and other indigenous wildlife species. The purpose of the Proposed Action is to compensate, in part, for wildlife habitat lost from the construction of Grand Coulee Dam and the inundation of Lake Roosevelt. Bonneville Power Administration proposes to fund management agreements, conservation easements, acquisition of fee title, or a combination of these on as many as 29,000 acres in Lincoln and Douglas Counties to improve shrub-steppe and riparian habitat for sharp-tailed grouse and pygmy rabbits. The BPA also proposes to fund habitat improvements (enhancements) on project lands including existing public lands. Proposed habitat treatments would include control of grazing; planting of native trees, shrubs, forbs and grasses; protection of wetlands and streambanks; herbicide use; fire prescriptions; and wildfire suppression. Proposed management activities may include predator control, population introductions, and control of crop depredation.

6562 (DOE/EIS–0157-Vol.1) **Final Environmental Impact Statement and Environmental Impact Report for continued operation of Lawrence Livermore National Laboratory and Sandia National Laboratories, Livermore: Volume 1, Text.** USDOE San Francisco Field Office, Oakland, CA (United States); California Univ., Berkeley, CA (United States). Aug 1992. 1003p. Sponsored by USDOE, Washington, DC (United States). (SCH–90030847). Order Number DE93003129. Source: OSTI; NTIS; INIS; GPO Dep.

This Environmental Impact Statement/Environmental Impact Report (EIS/EIR) is prepared pursuant to the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA). This document analyzes the potential environmental impacts of the proposed action: continued operation, including near-term (within 5 to 10 years) proposed projects, of Lawrence Livermore National Laboratory (LLNL) and Sandia National Laboratories, Livermore (SNL, Livermore). Additionally, this document analyzes a no action alternative involving continuing operations at FY 1992 funding levels without further growth, a modification of operations alternative to reduce adverse environmental impacts of operations or facilities, and a shutdown and decommissioning alternative of UC discontinuing its management of LLNL after the current contract expires on September 30, 1992. This document assesses the environmental impacts of the Laboratories' operations on air and water quality, geological and ecological systems, occupational and public health risks, prehistoric and historic resources, endangered species, floodplains and wetlands, socioeconomic resources, hazardous waste management, site contamination, and other environmental issues. The EIS/EIR is divided into five volumes and two companion reports. This volume contains the Final EIS/EIR, which in part relies on the detailed information in the appendices, and comprehensively discusses the proposed action, the alternatives, and the existing conditions and impacts of the proposed action and the alternatives.

6563 (DOE/EIS–0157-Vol.2) **Final Environmental Impact Statement/Environmental Impact Report for continued operation of Lawrence Livermore National Laboratory and Sandia National Laboratories, Livermore: Volume 2, Appendices A–D.** USDOE San Francisco Field Office, Oakland, CA (United States); California Univ., Berkeley, CA (United States). Aug 1992. 672p. Sponsored by USDOE, Washington, DC (United States). (SCH–90030847). Order Number DE93003130. Source: OSTI; NTIS; INIS; GPO Dep.

This Environmental Impact Statement/Environmental Impact Report (EIS/EIR) is prepared pursuant to the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA). This document analyzes the potential environmental impacts of the proposed action: continued operation, including near-term (within 5 to 10 years) proposed projects, of Lawrence Livermore National Laboratory (LLNL) and Sandia National Laboratories, Livermore (SNL, Livermore). Additionally, this document analyzes a no action alternative involving continuing operations at FY 1992 funding levels without further growth, a modification of operations alternative to reduce adverse environmental impacts of operations or facilities, and a shutdown and decommissioning alternative of UC discontinuing its management of LLNL after the current contract expires on September 30, 1992. This document assesses the environmental impacts of the Laboratories' operations on air and water quality, geological and ecological systems, occupational and public health risks, prehistoric and historic resources, endangered species, floodplains and wetlands, socioeconomic resources, hazardous waste management, site contamination, and other environmental issues. The EIS/EIR is divided into five volumes and two companion reports. This volume contains the Final EIS/EIR technical appendices which provide technical support for the analyses in Volume 1 and also provide additional information and references.

6564 (DOE/EIS–0157-Vol.3) **Final Environmental Impact Statement and Environmental Impact Report for continued operation of Lawrence Livermore National Laboratory and Sandia National Laboratories, Livermore: Volume 3, Appendices F–M.** USDOE San Francisco Field Office, Oakland, CA (United States); California Univ., Berkeley, CA (United States). Aug 1992. 475p. Sponsored by USDOE, Washington, DC (United States). (SCH–90030847). Order Number DE93003131. Source: OSTI; NTIS; INIS; GPO Dep.

This Environmental Impact Statement/Environmental Impact Report (EIS/EIR) is prepared pursuant to the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA). This document analyzes the potential environmental impacts of the proposed action: continued operation, including near-term (within 5 to 10 years) proposed projects, of Lawrence Livermore National Laboratory (LLNL) and Sandia National Laboratories, Livermore (SNL, Livermore). Additionally, this document analyzes a no action alternative involving continuing operations at FY 1992 funding levels without further growth, a modification of operations alternative to reduce adverse environmental impacts of operations or facilities, and a shutdown and decommissioning alternative of UC discontinuing its management of LLNL after the current contract expires on September 30, 1992. This document assesses the environmental impacts of the Laboratories' operations on air and water quality, geological and ecological systems, occupational and public health risks, prehistoric and historic resources, endangered species, floodplains and wetlands, socioeconomic resources, hazardous waste management, site contamination, and other environmental issues. The EIS/EIR is divided into five volumes and two companion reports. This volume contains the Final EIS/EIR technical appendices F through M. Appendix L has been revised to reflect public information activities since publication of the Draft EIS/EIR. These appendices provide technical support for the analyses in Volume 1 and also provide additional information and references.

6565 (DOE/EIS–0157-Vol.4) **Final Environmental Impact Statement and Environmental Impact Report for continued operation of Lawrence Livermore National Laboratory and Sandia National Laboratories, Livermore: Volume 4, Comments and responses.** USDOE San Francisco Field Office, Oakland, CA (United States); California Univ., Berkeley, CA (United States). Aug 1992. 864p. Sponsored by USDOE, Washington, DC (United States). (SCH–90030847). Order Number DE93003132. Source: OSTI; NTIS; INIS; GPO Dep.

This Environmental Impact Statement/Environmental Impact Report (EIS/EIR) is prepared pursuant to the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA). This document analyzes the potential environmental impacts of the proposed action: continued operation, including near-term (within 5 to 10 years) proposed projects, of Lawrence Livermore National Laboratory (LLNL) and Sandia National Laboratories, Livermore (SNL, Livermore). Additionally, this document

analyzes a no action alternative involving continuing operations at FY 1992 funding levels without further growth, a modification of operations alternative to reduce adverse environmental impacts of operations or facilities, and a shutdown and decommissioning alternative of UC discontinuing its management of LLNL after the current contract expires on September 30, 1992. This document assesses the environmental impacts of the Laboratories' operations on air and water quality, geological and ecological systems, occupational and public health risks, prehistoric and historic resources, endangered species, floodplains and wetlands, socioeconomic resources, hazardous waste management, site contamination, and other environmental issues. The EIS/EIR is divided into five volumes and two companion reports. This volume contains copies of the written comments and transcripts of individual statements at the public hearing and the responses to them.

6566 (DOE/ID/12584–T2) **Commercially available broadband electromagnetic systems for US Department of Energy waste-site characterization.** MacLean, H.D. Chem-Nuclear Geotech, Inc., Grand Junction, CO (United States). Jun 1992. 80p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-86ID12584. Order Number DE93002871. Source: OSTI; NTIS; INIS; GPO Dep.

Commercially available induction electromagnetic (EM) systems were investigated and evaluated to identify systems that could be readily and optimally configured for the characterization of US Department of Energy (DOE) waste disposal sites. In general, the evaluation addresses modern broadband EM (BBEM) systems that can locate conductive objects three dimensionally and provide information on the size-conductivity parameter of the conductor. In addition commercially available interpretation systems and software applicable to the analysis and interpretation of the BBEM data were reviewed. Nineteen EM systems were categorized by. their cot configuration as moving coil or fixed transmitter and by their method of data acquisition as frequency domain (FDEM) and time domain (TDEM). Tables 1 and 2 summarize the systems examined in this study. For characterization of waste sites, the TDEM systems offer definite advantages: the systems acquire BBEM data rapidly, are highly sensitive, and can be configured to operate in either the moving-coil or the fixed-transmitter mode. TDEM systems that acquire data in the absence of the primary field are highly sensitive and relatively free of noise caused by variations in the system geometry. Three TDEM systems were identified that operate over a large equivalent frequency range and have the other characteristics deemed necessary for site characterization work: (1) the Geonics PROTEM, (2) the Zonge GDP-16, and (3) the Zonge Nanotem. These systems were also selected for future field evaluation.

6567 (DOE/MC/11076–93/C0080) **Bell Pole CROW pilot test results and evaluation.** Fahy, L.J. (Western Research Inst., Laramie, WY (United States)); Johnson, L.A. Jr.; Sola, D.V.; Horn, S.G.; Christofferson, J.L. Western Research Inst., Laramie, WY (United States). [1992]. 31p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC21-86MC11076. (CONF-9210210–1: Colorado Hazardous Waste Management Society annual conference, Denver, CO (United States), Oct 1992). Order Number DE93002713. Source: OSTI; NTIS; GPO Dep.

Beginning in 1990, efforts were initiated to implement an in situ remediation project to address the creosote and pentachlorophenol (PCP) contaminated surficial aquifer at the Bell Lumber and Pole Company (Bell Pole) Site. The remediation project involves the application of the Contained Recovery of Oily Wastes (CROW™) process which consists of hot-water injection to displace and recover the non-aqueous phase liquids (NAPL). Based on the results from the pilot test the following conclusions can be made: (1) The pilot test provided sufficient hydraulic information to design the full-scale CROW remediation system. The pumping test portion of the pilot test indicated uniform aquifer properties. The entire thickness of the aquifer reached the target temperature range and containment of the injected hot water was achieved. (2) Pretest injection and production rate predictions were achieved. (3) The post test soil boring data indicated hot-water injection displaced greater than 80% of the NAPL near the injection well. The data indicates that a NAPL saturation of approximately 19% (pore volume basis) and a 500 fold decrease in PCP concentration can be achieved with 20 pore volumes of flushing. (4) The treatment system used during the pilot test was effective in reducing PCP and PAH compounds to concentrations acceptable for sanitary sewer discharge. (5) The microbial assay of the post test samples found an encouraging increase in microbial population compared to earlier data collected before the pilot test.

6568 (DOE/NV–357-Ver.1) **Summary of the Nevada Applied Ecology Group and correlative programs: Version 1.** Friesen, H.N. (Raytheon Services Nevada, Las Vegas, NV (United States)). USDOE Nevada Field Office, Las Vegas, NV (United States); Raytheon Services Nevada, Las Vegas, NV (United States). Oct 1992. 148p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-91NV10833. Order Number DE93002394. Source: OSTI; NTIS; INIS; GPO Dep.

This summary document presents results in a broad context; it is not limited to findings of the Nevada Applied Ecology Group. This book is organized to present the findings of the Nevada Applied Ecology Group and correlative programs in accordance with the originally stated objectives of the Nevada Applied Ecology Group. This plan, in essence, traces plutonium from its injection into the environment to movement in the ecosystem to development of cleanup techniques. Information on other radionuclides was also obtained and will be presented briefly. Chapter 1 presents a brief description of the ecological setting of the Test Range Complex. The results of investigations for plutonium distribution are presented in Chapter 2 for the area surrounding the Test Range Complex and in Chapter 3 for on-site locations. Chapters 4 and 5 present the results of investigations concerned with concentrations and movement, respectively, of plutonium in the ecosystem of the Test Range Complex, and Chapter 6 summarizes the potential hazard from this plutonium. Development of techniques for cleanup and treatment is presented in Chapter 7, and the inventory of radionuclides other than plutonium is presented briefly in Chapter 8.

6569 (DOE/NV/10845–T2) **Field activities near the Shoal Site, Sand Springs Range, Nevada.** Mihevc, T. Nevada Univ., Reno, NV (United States). Water Resources Center. Nov 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-90NV10845. Order Number DE93005916. Source: OSTI; NTIS; GPO Dep.

Water samples were collected from four wells in the Shoal Site region for the following analysis: enriched tritium; stable isotopes of oxygen and hydrogen; carbon-13, carbon-14; and gross chemistry. A list of field parameters measured and chemical analyses that are completed at this time are presented in Table 1.

6570 (ESH-EMS–92-0035) **The Savannah River Site's Groundwater Monitoring Program: First quarter 1992.** Westinghouse Savannah River Co., Aiken, SC (United States); Exploration Resources, Inc., Athens, GA (United States). 3 Aug 1992. 740p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93006398. Source: OSTI; NTIS; INIS; GPO Dep.

This report summarizes the Savannah River Site (SRS) groundwater monitoring program conducted during the first quarter of 1992. It includes the analytical data, field data, data review, quality control, and other documentation for this program; provides a record of the program's activities; and serves as an official document of the analytical results.

6571 (GSF–7/91) **Experience with column experiments for the determination of the pollutant migration.** Klotz, D. (GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany). Inst. fuer Hydrologie). GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany). Jun 1992. 118p. (In German). Order Number DE93742813. Source: OSTI; NTIS (US Sales Only).

In columns and/or lysimeter arrangements in the laboratory and/or in field experiments, transport processes of pollutants can be simulated under controlled conditions in order to determine the behavior of the pollutants in the natural underground. Set-up and operation of the columns occur under different question formulations which require different experimental setups. At the GSF Institute for Hydrology, four types of columns are used for water-saturated and water-unsaturated flow in the laboratory and ground.

It is shown how the requirements on columns for simulation of natural seepage flow and groundwater flow are implemented by specific components and modules. The four types of column arrangements differ according to the porous medium used (cohesive material, sand, gravel, comminuted solid rock), according to the operating conditions (simulated groundwater or seepage water flow), and according the pollutant concentration (material of the components). Otherwise, the components of the column arrangements are interchangeable with one another. (orig.).

6572 (INIS-BR–3060) **Geophysical characterization from Itu Intrusive suite.** Pascholati, M.E. Sao Paulo Univ., SP (Brazil). Inst. Astronomico e Geofisico. 1989[154] (In Portuguese). Order Number DE93609078. Source: OSTI; NTIS (US Sales Only); INIS.

The integrated use of geophysical, geological, geochemical, petrographical and remote sensing data resulted in a substantial increase in the knowledge of the Itu Intrusive Suite. The main geophysical method was gamma-ray spectrometry together with fluorimetry and autoradiography. Three methods were used for calculation of laboratory gamma-ray spectrometry data. For U, the regression method was the best one. For K and Th, equations system and absolute calibration presented the best results. Surface gamma-ray spectrometry allowed comparison with laboratory data and permitted important contribution to the study of environmental radiation. (author).

6573 (INIS-BR–3068) **Study of C^{13}/C^{12} and O^{18}/O^{16} variations on environments of beach rocks formation in Itaparica Island - Bahia.** Campos, H.S. Bahia Univ., Salvador, BA (Brazil). 1976[61] (In Portuguese). Order Number DE93609068. Source: OSTI; NTIS (US Sales Only); INIS.

Calcium carbonate-cemented beach sands or beach rocks have been observed to occur in the inter tidal zone of many tropical beaches. Near Salvador (Brazil) occurrences are found in several locations on the island of Itaparica. A study of the stable isotope composition (C^{13}/C^{12} and O^{18}/O^{16}) of the cement and the local groundwater was carried out to determine the origin of the carbonate cement. (author).

6574 (INIS-BR–3070) **Petrographic, mineralogical, geochemical and paleo environmental characterization of radioactive anomaly associated to carbonate rocks from Jandaira formation of high cretaceous from Potiguar basin - Rio Grande do Norte - Brazil.** Matsuda, N.S. Ouro Preto Univ., MG (Brazil). Escola de Minas. 1988[155] (In Portuguese). Order Number DE93609069. Source: OSTI; NTIS (US Sales Only); INIS.

The Jandaira Formation (Turonian/Maastrichtian - Potiguar Basin, Brazil) presents an anomalous radioactive marker in the upper part of its carbonatic section. This marker of 3-20 m in thickness, comprises an area of about 3500 Km^2 and shows a radioactivity of 470 UAPI, against a background of 20 UAPI on the Gamma Ray Log. In the effort of characterizing this marker, petrological, mineralogical, geological and paleontological, analyses were made in ditch samples of selected 23 wells. This marker is composed by bioclastics packstones to mudstones, mainly constituted of planktonic and bentonic forams, deposited in relatively deep water. Chemical analysis of the P 205 richest samples, the ones show that they are also enriched on U, F, As, Cr, Cu, Mo, Ni, Pb, S, Se, V, Y, Yb and on all rare-earth elements. The origin of the radioactive anomaly is due to the presence of sedimentary phosphates (phosphorite) made-up of uraniferous coloform apatite. (author).

6575 (INIS-BR–3088) **Method of rare earths determination, with separation pre-irradiation followed by neutron activation analysis. Using of brazilian standards BB-1 and GB-1.** Alcala, A. (Instituto de Pesquisas Energeticas e Nucleares (IPEN), Sao Paulo, SP (Brazil)); Figueiredo, A.M.G.; Marques, L.S.; Astolfo, R. Instituto de Pesquisas Energeticas e Nucleares (IPEN), Sao Paulo, SP (Brazil). [1992][11] (In Portuguese). Order Number DE93608793. Source: OSTI; NTIS (US Sales Only); INIS.

In order to determine the rare earth elements (REE) in rocks, by neutron activation analysis, a group separation, before irradiation, was developed. The brazilian geological standards BB-1 and GB-1, provided by Instituto de Geociencias da Universidade da Bahia, were analyzed. The method was based an acid digestion of the samples, cation exchange separation with a Dowex 50WX8 column and coprecipitation of the REE with calcium oxalate. Interferers like U, Th, Ta and Fe were eliminated. The concentration values of ten REE (La, Ce, Pr, Nd, Sm, Eu, Tb, Ho, Yb and Lu) were determined. The analysis of Pr brought a contribution to the knowledge of the REE contents in these geological standards, since there are not yet results in the literature. The other REE data obtained were compared with literature values and some discrepancies are discussed. (author).

6576 (INIS-mf–14097) **Status report of IMIS-IT. Seminar held on May 3, 1991 for a review of the IMIS project.** BfS Schriften. Bundesamt fuer Strahlenschutz, Salzgitter (Germany). 1992 150p. (In German). Order Number DE93744854. Source: OSTI; NTIS (US Sales Only); INIS.

The papers presented to the review seminar on the IMIS-IT project (Integriertes Mess- und InformationsSystem - InformationsTechnik) show the major results achieved, experience gained, and planned future activities. Up to that date, data processing problems were rather dominating, also because subject-related aspects or problems for some part were recognized or emerged only after the project became operational. (BBR).

6577 (LA-UR–92-3371) **Estimating species diversity from bird atlas data.** Campbell, K. Los Alamos National Lab., NM (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-920893–6: Joint statistical meetings of the American Statistical Association, the Biometric Society and the Institute of Mathematical Statistics, Boston, MA (United States), 9-13 Aug 1992). Order Number DE93003731. Source: OSTI; NTIS; GPO Dep.

Observations for a breeding bird atlas for Los Alamos (NM) county were collected over a six-year period by a number of different observers and with variable number and duration of visits to different parts of the county. The resulting data set, while thorough by the standards of such atlases, poses many problems for statistical analyses proposed after data gathering was complete. This paper examines some statistical models that might usefully supplement the data and make possible inferences about such questions as the impact of land use – residential, Laboratory, wilderness – on the use of local habitats by approximately 100 species known to breed in the county.

6578 (LBL-PUB–5350) **Mitigation Monitoring Plan.** Lawrence Berkeley Lab., CA (United States); Fink (Ira) and Associates, Inc., Berkeley, CA (United States). Sep 1992. 46p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE93000586. Source: OSTI; NTIS; GPO Dep.

The Final Supplemental Environmental Impact Report (SEIR) (September 1992) for the Proposed Renewal of the Contract between the United States Department of Energy and The Regents of the University of California for the Operation and Management of the Lawrence Berkeley Laboratory identifies the environmental impacts associated with renewing the contract and specifies a series of measures designed to mitigate adverse impacts to the environment. This Mitigation Monitoring Plan describes the procedures the University will use to implement the mitigation measures adopted in connection with the approval of the Contract.

6579 (LUTFD2-TFKF–3061/1990) **Survey of radon in the commune of Kristianstad.** Joensson, G. (Lund Univ. (Sweden). Dept. of Physics); Konrfaelt, K.A.; Ringberg, B.; Tell, I. Lund Univ. (Sweden). Dept. of Physics. May 1990. [43] (In Swedish). Order Number DE93609070. Source: OSTI; NTIS; INIS.

Presents results of an investigation of radon in the ground. 300 measurements, 0.7 m under the ground level have been carried out.

6580 (LUTFD2-TFKF–3062/1990) **Survey of radon in the commune of Svedala.** Joensson, G. (Lund Univ. (Sweden). Dept. of Physics); Persson, M.; Tell, I. Lund Univ. (Sweden). Dept. of Physics. Jun 1990. [54] (In Swedish). Order Number DE93609071. Source: OSTI; NTIS; INIS.

Presents results of an investigation of radon in the ground. 200 measurements, 0.7 m under the ground level have been carried out.

6581 (LUTFD2-TFKF–3063/1990) **Survey of radon in the commune of Lund.** Joensson, G. (Lund Inst. of Technology (Sweden). Dept. of Physics); Ringberg, B.; Daniel, E.; Sivhed, U.; Wikman, H. Lund Univ. (Sweden). Dept. of Physics. Jul 1990. [53] (In Swedish). Order Number DE93609072. Source: OSTI; NTIS; INIS.

Presents results of an investigation of radon in the ground. 260 measurements, 0.7 m under the ground level have been carried out.

6582 (NEI-DK–1007) **Field studies of leachate from landfilled combustion redidues.** Hjelmar, O. Vandkvalitetsinstituttet, Hoersholm (Denmark). 1991 12p. Contract EM-1323/88-5. (CONF-9111186–1: WASCON '91: international conference on environmental implications of construction with waste materials, Maastricht (Netherlands), 10-14 Nov 1991). Order Number DE93752823. Source: OSTI; NTIS.

EFP-88.

This paper presents some leachate quality data from two municipal solid waste incenerators (MSWI) ash monofills, a marine land reclamation site containing both MSWI ash and coal fly ash and a parking lot where MSWI bottom ash has been used as sub-base. All the sites are located near Copenhagen, Denmark. The leaching data from the two MSWI ash monofills have been presented previously (1-2) and in this paper they are merely updated with observations from 1989-1991 to cover total periods of 19 and 9 years, respectively. Wherever possible it has been attempted to relate the leachate quality data to the total amount of leachate produced in terms of the liquid/solid ratio. A few results of laboratory leaching tests on MSWI bottom and combined ash are also presented. There is a good general agreement between the field observation and the laboratory results, particularly if the different redox conditions are taken into account. All results show that inorganic salts and organic matter are the major constituents of the initial leachate. Trace metals are generally found in relatively low levels in the leachate. Both field and laboratory results indicate that the content of ammonia in the leachate may remain at a relatively high level during a long period of time. It is recommended that the effort to procure reliable long term observations is increased. (au).

6583 (NEI-DK–1010) **Leaching properties of substances from marine-deposited combustion wastes.** Energiministeriets Energiforskningsprogram. Miljoe og restprodukter. Aagaard Hansen, E.; Hjelmar, O. Vandkvalitetsinstituttet, Hoersholm (Denmark). Sep 1992. 161p. (In Danish). Contract EM-1323/88-5. Order Number DE93752803. Source: OSTI; NTIS.

EFP-88.

During the period 1986-1991/92, approximately 640,000 tons of coal fly ash (CFA) and 535,000 tons of municipal solid waste incinerator (MSWI) ash (fly ash and bottom ash) have been used as a filling material in a land reclamation disposal site at a new coal-fired power plant at Avedoere, Denmark. A shallow coastal area of a maximum water depth of ca. 2 m was surrounded by dikes and gradually filled up by backtipping the combustion residues to a total height of 2-3 m above sea level. The dikes and the bottom of the site are water-permeable and a top cover of clay restricts the infiltration of precipitaion into the finalized parts of the site. The leaching and hydraulic properties of the depositied residues were investigated in order to provide and estimate of the emission of selected trace elements. The results are given in detail. The composition of the leachates collected from various parts of the site appear to a certain degree to reflect the type of residues deposited. Relatively high concentrations of NVOC and ammonia-N were found in the leachates from deposited MSWI ash, whereas the presence of measurable concentrations of Cr appeared only in areas containing CFA without MSWI ash. Significant differences were found between residue permeabilities determined in the field (higher) and in the laboratory (lower). One field measurement gave a permeability of ca. 10^{-5} m/s for deposited CFA. This may have a serious impact on future evaluations of hydraulic conditions in coal fly ash disposal sites. It is recommended that it should be ensured that water displaced from the diked area will pass through deposited residues before it flows through the bottom and/or the dikes. (AB).

6584 (NEI-DK–1022) **Statistics on the environment in Copenhagen 1992.** Miljoekontrollen, Copenhagen (Denmark); Koebenhavns Kommune, Copenhagen (Denmark). Statistik Kontor. 1992. 66p. (In Danish). Order Number DE93752798. Source: OSTI; NTIS.

This presentation of data on the environment in Copenhagen, Denmark, is intended to give information on how the quality of the environment and the factors that influence it have developed during the last few years. A number of background factors on human activities primarily concerned with housekeeping, industry and traffic conditions, which can originate pollution, are described. Pollution sources, with regard to noise pollution, wastes and sewage are dealt with. The actual quality of the environment in this Danish urban area is characterized, and conditions of air, soil, water and noise pollution are clarified. Initiatives taken to reduce pollution in the area are explained, also in relation to the involved local authority expences. Data is presented in the form of graphs, tables and small maps. (AB).

6585 (NEI-DK–1026) **Degradation of diesel oil in unsaturated soil: Laboratory investigations. Report A2. Sanitary landfill project.** Lindhardt, B. (Laboratoriet for teknisk Hygiejne, DTH (Denmark)); Jacobsen, J.; Meldgaard Andersen, E. Miljoestyrelsen, Copenhagen (Denmark). Nov 1991. 85p. (In Danish). Order Number DE93752974. Source: OSTI; NTIS.

Laboratory experiments were conducted in order to investigate the possibility of promoting microbial degradation of diesel in a sandy soil by areating alone, or whether it would be necessary to add nutrients. It was also investigated whether it is sufficient to add nitrogen before oxidation, or necessary to add phosphate and micro nutrients as well. It was found that the latter was necessary. The addition of nitrate and phosphate reduces diesel oil concentration by ca. 50% during a period of 50 - 192 days. The ratio between carbon in the oil and the nitrate in the soil reaches 21:1, and the ratio between carbon and the leachable phosphate reaches 150:1. In the experimental series where the content of oil in the soil is rapidly reduced, - after a short lag period of ca. 8 days the content of ATP increased from between 30-160 ng/g to 270-940 ng/g. A change in the composition of the soil only occurs when nitrate and phosphate is added. Addition of micro-nutrients to the fertilized water has little positive effect on degradation. The addition of nitrate and phosphate will cause degradation rates of between 0.014 and 0.061 g/(kg.day). The content of all identified substances is reduced by biodegradation. Changes in the composition of the oil, the ratio of n-alkanes and the ratio between pristane and n-C_{17}, together with the ratio between phytane and n-C_{18} respectively, are estimated to be appropriate parameters for following the introductory microbial degradation of diesel oil because these parameters are independent of the total concentration of oil. (AB).

6586 (ORNL/ER/Sub–91-KA931/4) **White Oak Creek Embayment time-critical CERCLA removal action sediment-retention structure: Environmental Restoration Program.** Oak Ridge National Lab., TN (United States). Environmental Restoration Div.; CDM Federal Programs Corp., Oak Ridge, TN (United States). Sep 1992. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93001420. Source: OSTI; NTIS; GPO Dep.

Over a 20-month period between September 1990 and April 1992, the Department of Energy (DOE), acting through Martin Marietta Energy Systems, Inc., managing contractor for the DOE Oak Ridge Field Office (DOE-OR), conducted a DOE-lead and DOE-funded time-critical removal action at the White Oak Creek Embayment (WOCE), pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The time-critical removal action specifically consisted of the design and construction of a sediment-retention structure across the mouth of WOCE to prevent off-site migration of sediments contaminated by cesium (^{137}Cs) into the Clinch River. Construction of a sediment-retention structure was completed in mid-April 1992. The purpose of this report is to meet the substantive requirements of 40 CFR 300.165 describing "a complete report on the removal operation and the actions taken." This section of the NCP specifically addresses on-scene coordinator reports for the Environmental Protection Agency (EPA) Superfund-lead actions and includes several

elements that are not applicable to this DOE-lead action. Only those sections that are pertinent and applicable are addressed in this final report.

6587 (ORNL/RASA–92/12) **Results of the radiological survey at the Town of Tonawanda Landfill, Tonawanda, New York (TNY001).** Rodriguez, R.E.; Murray, M.E.; Uziel, M.S. Oak Ridge National Lab., TN (United States). Oct 1992. 39p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93003672. Source: OSTI; NTIS; INIS; GPO Dep.

At the request of the US Department of Energy (DOE), a team from Oak Ridge National Laboratory conducted a radiological survey at the Town of Tonawanda Landfill, Tonawanda, New York. The survey was performed in September 1991. The purpose of the survey was to determine if radioactive materials from work performed under government contract at the Linde Air Products Division of Union Carbide Corporation, Tonawanda, New York, had been deposited in the landfill. The survey included a surface gamma scan and the collection of soil samples for radionuclide analyses. Results of the survey suggest that material originating at the Linde plant may have been deposited in the landfill. Soil samples S54 and B12 contained technologically enhanced levels of ^{238}U not unlike the product formerly produced by the Linde plant. In contrast, samples B4A, B5A and B7B, containing elevated concentrations of ^{226}Ra and ^{230}Th with much lower concentrations of ^{238}U, were similar to the residue or byproduct of the refinery operation conducted at the Linde plant. In 24 instances, soil samples from the Town of Tonawanda Landfill exceeded DOE guideline values for ^{238}U, ^{226}Ra, and/or ^{230}Th in surface or subsurface soil. Nine of these samples contained radionuclide concentrations more than 30 times the guideline value.

6588 (SA-PUB–3/92, pp. 147-155) **The impact of changing atmospheric properties on soil, forest productivity and resistance.** Hari, P. (Helsinki Univ. (Finland). Dept. of Forest Ecology); Westman, C.J.; Ilvesniemi, H.; Jauhiainen, M.; Nikinmaa, E.; Nissinen, A.; Snicker, J.; Ylimartimo, A. Academy of Finland, Helsinki (Finland). 1992. In *The Finnish research programme on climate change: Progress report.* 310p. Order Number DE93752870. Source: OSTI; NTIS.

SILMU Research Programme.

The aim of our SILMU-project is to analyze the changes in the mass and energy flows in forest ecosystems caused by changing atmospheric composition and climate, and the effects of such changes on the forest growth and the resistance to disease of Finnish forests. The main subprojects are: Site hydrological properties and the chemical equilibrium between forest soil matrix and soil solution; The response of root respiration and dry matter partitioning to aluminium addition at different root temperatures and nutrient treatments; Photosynthetic response of trees to changes in environmental factors; Effect of environmental changes on the resistance of trees to fungal infections; An analysis of Scots Pine growth from a functional balance point of view. Only subprojects 1. and 3. are funded mainly by the SILMU- project, but all subprojects are carried out in close association with each other and the SILMU-project. An outline of each subproject is given separately.

6589 (SA-PUB–3/92, pp. 304-308) **Environmental change, greenhouse effect and ways of life.** Jaervelae, M. (Tampere Univ. (Finland). Research Institute for Social Sciences). Academy of Finland, Helsinki (Finland). 1992. In *The Finnish research programme on climate change: Progress report.* 310p. Order Number DE93752870. Source: OSTI; NTIS.

SILMU Research Programme.

The purpose of the project is to carry out an inquiry among certain professional groups occupying key positions of influence in Finland, asking them to present their social definitions of what are regarded as the most serious global threats to the environment. The views of each professional elite will be discussed with reference to the concepts of 'greenhouse effect', 'way of life' and of 'sustainable development'. This includes the idea of discussing social and economic solidarity between successive generations. Furthermore, the conceptions held by each group of environmental policies will be analysed with reference to a teleological model of rational action. The baseline assumption is that different elites tend to 'professionalize' approaches to global environmental problems and policies of dealing with these problems in different ways. However, on the basis of the social functions of professional elites, a general typology can be presented by way of an initial frame of reference. There are five distinct elites: technical and economic elite, political elite, cultural elite, 'risk experts', and 'moral resistance'. The intellectual orientations represented by the first four groups are variants of the rational action strategies pursued by professional elites. 'Moral resistance' represents a more critical approach that deals basically with alternative or utopian ways of life. A primary concern in the early stages of the project is with the internal integration of professional elites. Later, an evaluation will be presented of the competence of different professional elites for mutual communication, with special reference to national and international policies concerning the greenhouse effect. Other aspects of communication, such as the problems of dialogue between experts and lay people, will also be discussed.

6590 (SRO–819-21) **Communicating science: Volume 2, Annual report for the period ending July 31, 1990.** Moorhead, K.K.; Neal, S.A. (eds.). Savannah River Ecology Lab., Aiken, SC (United States). [1990]. 76p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00819. Order Number DE93004451. Source: OSTI; NTIS; GPO Dep.

This volume of the 1990 Savannah River Ecology Laboratory (SREL) Annual Report contains technical supplements for Volume I. These have been provided to supplement the general information on research highlights given in Volume I. A bibliography of SREL publications and presentations is included along with abstracts from 41 papers on the subjects of biogeochemical ecology, stress and wildlife ecology,and wetlands ecology.

6591 (TVA/NFERC–91/5) **Amnesty day experiences in various states.** Gilmore, M.E. National Fertilizer and Environmental Research Center, Muscle Shoals, AL (United States). [1991]. 124p. Sponsored by Tennessee Valley Authority, Knoxville, TN (United States). (TVA-Bull–Z-292). Order Number DE93003929. Source: OSTI; NTIS.

The Tennessee Valley Authority's National Fertilizer and Environmental Research Center hosted a pesticide amnesty day. This document discusses the topics of liability, funding, and goals of the disposal of pesticides and household hazardous wastes. A state by state listing of disposal means along with the results of a questionnaire concerning the individual methods used is given.

6592 (USGS-WRI–88-4219) **An investigation of shallow ground-water quality near East Fork Poplar Creek, Oak Ridge, Tennessee.** Carmichael, J.K. Geological Survey, Nashville, TN (United States). 1989. 49p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI05-86OR21674. Order Number DE93005055. Source: OSTI; NTIS; INIS; GPO Dep.

Alluvial soils and fill materials in and near the flood plain of East Fork Poplar Creek in Oak Ridge, Tennessee, are contaminated with various trace metals (primarily mercury), organic compounds, and radionuclides that were lost to the stream as a result of past operations at the Y-12 Plant, a nuclear-processing facility located within the US Department of Energy's Oak Ridge Reservation. Observation wells were installed in the shallow (above bedrock) aquifer in and near the flood plain of East Fork Poplar Creek and water-quality samples were collected to determine if contaminants found in the soils and fill are also present in the shallow ground water. Results are described.

6593 (VTT-OPT–45, pp. 40-42) **Peat analytics and the environmental protection.** Nyroenen, T. (Vapo Oy, Jyvaeskylae (Finland)). Technical Research Centre of Finland, Jyvaeskylae (Finland). Combustion and Thermal Engineering Lab. 1992. (In Finnish). Project KTM-275/881/87. In *Research results of the Optimiturve research program in 1991.* 69p. Order Number DE93752849. Source: OSTI; NTIS.

OPTIMITURVE Research Programme.

The targets of this research have been: (1) to develop a method for determination of the heavy metal concentrations of the peat, and to determine them in different parts of Finland, (2) to develop a method for determination of water soluble nutrients and elements from mire inspection samples for better pre-estimation of possible

water course effects, and (3) to adjust the determination method for sulfur content of fuel peat, especially in the sense of calibration. The heavy metal determination method consists of acid dissolution of the samples (HNO3-H2O-HF, 5:4.5:0.5), micro wave dissociation, and determination of the heavy metals (Cd, Co, Cr, Cu, Ni, Pb and As) by graphite oven AAS (GFAAS), and flame AAS (Zn). Both the suitable conformation of the acid mixture and the analysis conditions were sought experimentally. The useability of the method was tested in two ring analysis between several laboratories and using certified reference samples. The determination of water soluble nutrients and elements was concentrated to testing of the pretreatment and fractionation methods following the water extraction, in order to separate the soluble parts from parts bound into solid matter. Centrifugation, suction and pressure filtration using different filters were tested as separation methods. The target was to develop the fraction so that the analysis results would correspond the water analysis results obtained from runoff waters of peat production areas. The combination of micro wave disintegration and GFAAS techniques appeared to be suitable for peat heavy metal analytics; it is sufficiently fast, repeatable and accurate.

6594 (VTT-TIED–1373) **Migration of pollutants in a saturated aquifer: A theoretical and experimental approach.** Carlsson, T. (Technical Research Centre of Finland, Espoo (Finland). Reactor Lab.); Manninen, P.; Olin, M. Technical Research Centre of Finland, Espoo (Finland). 1992. 50p. Order Number DE93752924. Source: OSTI; NTIS.

The report describes the testing of experimental methodology at the Reactor laboratory of the Technical Research Centre of Finland (VTT), for studying the water transport of e.g. pollutants in geological media. The methodology tested includes an experimental transportation migration box, automatic sampling, and HPLC-IC system. The systems testing was done using a migration box containing quartz sand through which the water flowed horizontally. At the beginning of each test inorganic or organic compounds were rapidly mixed with influent water. Samples were taken continuously from various sampling points in the sand and analyzed with the HPLC-IC technique. The results are presented in temporal concentration curves for each one of the species studied. Three tests were made in order to study the retention of inorganic anions and cations and some organic compounds. It was also found that the retention factors increase somewhat with increasing migration distance which is explained by dilution of the chemical pulse during its transportation through the aquifer. The present work shows that the methodology can successfully be used in the study of the transport of chemicals in porous geological media. The methodology is likely to be applicable also to other types of geological systems although this was not explicitly demonstrated.

6595 (WHC-EP–0554) **Vascular plants of the Hanford Site.** Sackschewsky, M.R. (Westinghouse Hanford Co., Richland, WA (United States)); Landeen, D.S.; Downs, J.L.; Rickard, W.H.; Baird, G.I. Westinghouse Hanford Co., Richland, WA (United States). Jul 1992. 190p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93003638. Source: OSTI; NTIS; GPO Dep.

An updated listing of the vascular plants of the Hanford Site is provided, along with discussions of how humans may interact with local plants and have influenced the regional flora. Based on examinations of herbarium collections at the Westinghouse Hanford Company, Pacific Northwest Laboratory, Washington State University, and Brigham Young University, 590 vascular plant species have been identified on or near the Hanford Site. This is more than twice the number of species on previously published lists of Hanford Site vascular plants. A review of the plant species that are currently listed as endangered, threatened, sensitive, or otherwise of concern to the Washington State Natural Heritage Program and the Federal Fish and Wildlife Service is included. Color photographs of selected species are included to aid identification. Lists are provided of the Hanford Site plant species that could be used as food and medicinal sources and of those introduced to the region through human activities. The information provided in this report will be useful to workers charged with performing environmental characterizations in the field, preparing environmental assessments for permitting purposes, performing risk assessments using transport-to-man scenarios, and selecting species for revegetation and environmental reconstruction projects.

6596 (WSRC-MS–92-175-Rev.1) **Progress in the environmental restoration at the Savannah River Site (SRS): Revision 1.** Pope, J.M. (Westinghouse Savannah River Co., Aiken, SC (United States)); McClain, L. Westinghouse Savannah River Co., Aiken, SC (United States); USDOE Savannah River Field Office, Aiken SC (United States). [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. (CONF-920851–84-Rev.1: Spectrum '92: nuclear and hazardous waste management international topical meeting, Boise, ID (United States), 23-27 Aug 1992). Order Number DE93002695. Source: OSTI; NTIS; INIS; GPO Dep.

The Environmental Restoration (ER) Program has continued to achieve significant accomplishments important to the mission of cleaning up inactive waste sites, performing corrective actions on contaminated groundwater, planning for decontaminating/decommissioning surplus facilities and ensuring that the environment and the health and safety of people are protected. The multifaceted cleanup at SRS represents noteworthy milestones across the DOE complex. The associated lessons learned and key elements of the progress will be presented in the course of the paper.

6597 (Y/SUB–92-YP507C/1/P2) **Groundwater quality assessment for the Bear Creek Hydrogeologic Regime at the Y-12 Plant: 1991 groundwater quality data interpretations and proposed program modifications.** Oak Ridge Y-12 Plant, TN (United States); HSW Environmental Consultants, Inc., Oak Ridge, TN (United States). Aug 1992. 178p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OS21400. Order Number DE93002752. Source: OSTI; NTIS; INIS; GPO Dep.

1991 groundwater quality data interpretations and proposed program modifications.

This report contains an evaluation of the groundwater and surface-water quality data obtained during the 1991 calendar year at several management facilities associated with the US Department of Energy Y-12 Plant. These sites are southwest of the Y-12 plant complex within the Bear Creek Hydrogeologic Regime (BCHR) which is one of three regimes defined for the purposes of groundwater and surface-water quality monitoring. Section 2.0 of this report contains background information regarding groundwater monitoring at the waste-management sites located in the BCHR. An overview of the hydrogeologic system in the BCHR is provided in Section 3.0. A discussion of the interpretive assumptions used in evaluating the 1991 assessment data and detailed descriptions of groundwater and surface-water quality in the regime are presented in Section 4.0. Findings of the 1991 monitoring program are summarized in Section 5.0. Proposed modifications to the groundwater and surface-water quality monitoring program in the BCHR are presented.

6598 (Y/SUB–92-YP507C/2/P2) **Groundwater quality assessment for the Upper East Fork Poplar Creek Hydrogeologic Regime at the Y-12 Plant: 1991 Groundwater quality data interpretations and proposed program modifications.** Oak Ridge Y-12 Plant, TN (United States); HSW Environmental Consultants, Inc., Oak Ridge, TN (United States). Aug 1992. 126p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OS21400. Order Number DE93002753. Source: OSTI; NTIS; INIS; GPO Dep.

This report contains an evaluation of the groundwater quality data obtained during the 1991 calendar year at several hazardous and non-hazardous waste management facilities and underground storage tanks (USTs) associated with the US Department of Energy Y-12 Plant. These sites are within the Upper East Fork Poplar Creek Hydrogeologic Regime (UEFPCHR), which is one of three regimes defined for the purposes of groundwater and surfacewater quality monitoring. Section 2.0 of this report contains background information regarding groundwater monitoring at the waste-management sites and USTs located in the UEFPCHR. An overview of the hydrogeologic system in the UEFPCHR is provided in Section 3.0. A discussion of the interpretive assumptions used in evaluating the 1991 assessment data, and detailed descriptions of groundwater quality are presented in Section 4.0. Findings of the

1991 monitoring program are summarized in Section 5.0. Proposed modifications to the groundwater quality monitoring program in the UEFPCHR are presented.

6599 (Y/SUB–92/YP507C/3/P2) **Groundwater quality assessment for the Chestnut Ridge Hydrogeologic Regime at the Y-12 Plant: 1991 Groundwater quality data interpretations and proposed program modifications.** Oak Ridge Y-12 Plant, TN (United States); HSW Environmental Consultants, Inc., Oak Ridge, TN (United States). Aug 1992. 97p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OS21400. Order Number DE93002755. Source: OSTI; NTIS; INIS; GPO Dep.

This report contains an evaluation of groundwater quality data obtained during the 1991 calendar year at several hazardous and non-hazardous waste-management facilities associated with the US Department of Energy Y- 12 Plant. These sites are located south of the Y- 12 Plant in the Chestnut Ridge Hydrogeologic Regime (CRHR), which is one of three regimes defined for the purposes of groundwater and surface-water quality monitoring. Section 2.0 of this report contains background information regarding groundwater monitoring at the waste-management sites located in the CRHR. An overview of the hydrogeologic system in the CRHR is provided in Section 3.0. A discussion of the interpretive assumptions used in evaluating the 1991 assessment data and detailed descriptions of groundwater quality in the regime are presented.

6600 (Y/SUB–92-YP507C/4) **Summary of groundwater and surface-water quality monitoring at the Y-12 Plant for 1993.** Oak Ridge Y-12 Plant, TN (United States); HSW Environmental Consultants, Inc., Oak Ridge, TN (United States). Aug 1992. 40p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OS21400. Order Number DE93002756. Source: OSTI; NTIS; INIS; GPO Dep.

This report contains a summary of the groundwater and surface-water quality monitoring activities to be performed during the 1993 calendar year at the Department of Energy Y- 12 Plant in Oak Ridge, Tennessee (Figure 1). Monitoring activities will be performed in three hydrogeologic regimes: (1) the Bear Creek Hydrogeologic Regime (BCHR), (2) the Upper East Fork Poplar Creek Hydrogeologic Regime (UEFPCHR), and (3) the Chestnut Ridge Hydrogeologic Regime (CRHR). The BCHR and UEFPCHR are located within Bear Creek Valley (BCV) and the CRHR is located south of the Y-12 Plant on Chestnut Ridge (Figure 2).

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Refer also to citation(s) 5035, 5045, 5146, 5150, 5152, 5154, 5186, 5187, 5188, 5264, 5265, 5266, 5673, 5691, 5718, 5832, 5833, 6087, 6113, 6120, 6466, 6470, 6476, 6477, 6482, 6492, 6535, 6553, 6554, 6558, 6559, 6562, 6563, 6564, 6565, 6567, 6576, 6583, 6584, 6590, 6593, 6597, 6600, 6671, 6697, 6727, 6781, 7473, 7474

6601 (CONF-9111236–, pp. 15-19) **Difficultly volatile chlorinated hydrocarbons in the rivers Elbe and Weser and in the German Bight.** Knauth, H.D. (GKSS-Forschungszentrum Geesthacht (Germany)); Sturm, R.; Milde, M.P. Arbeitsgemeinschaft der Grossforschungseinrichtungen (AGF), Bonn (Germany). 1991. 86p. (In German). From AGF meeting on ground pollution and water pollution: Stocktaking - carryover - redevelopment approaches; Bonn (Germany); 28-29 Nov 1991. In *Soil and water pollution.* Order Number DE93742729. Source: OSTI; NTIS (US Sales Only).

In 1987 and in 1988 water samples were collected at different locations in the rivers Elbe and Weser as well as in the southern part of the German Bight. The samples were separated into water and seston by continuous flow centrifugation in order to determine the concentrations of nonvolatile chlorinated hydrocarbons (CHC's) in both phases. The main objective of this investigation was to assess the degree of influence of Weser and Elbe on water bodies in the German Bight, using nonvolatile CHC's as anthropogenic tracers. Additional measurements at the outlets of sewage plants were performed to get information about possible sources of CHC's. (orig.).

6602 (CONF-9111236–, pp. 20-24) **Modelling of the transport of water pollutants in rivers with special regard to suspended matter.** Mueller, A. (GKSS-Forschungszentrum Geesthacht (Germany)); Grabemann, I.; Krohn, J.; Kunze, B.; Lobmeyr, M. Arbeitsgemeinschaft der Grossforschungseinrichtungen (AGF), Bonn (Germany). 1991. 86p. (In German). From AGF meeting on ground pollution and water pollution: Stocktaking - carryover - redevelopment approaches; Bonn (Germany); 28-29 Nov 1991. In *Soil and water pollution.* Order Number DE93742729. Source: OSTI; NTIS (US Sales Only).

GKSS Research Centre uses one-, two- and three-dimensional numerical river models. Continual further development of these models is carried out in close connection with field and laboratory investigations. For some years the one-dimensional model FLUSS is in operational application at the Bremen Water Authority. Structure and mode of operation of the models are described. The models ability of reproducing natural processes is discussed. (orig.).

6603 (CONF-9111236–, pp. 33-36) **Determination of the heavy metal release from sediments by nitrilo-triacetic acid.** Donnert, D. (Kernforschungszentrum Karlsruhe GmbH (KfK) (Germany)); Horst, J.; Eberle, S.H. Arbeitsgemeinschaft der Grossforschungseinrichtungen (AGF), Bonn (Germany). 1991. 86p. (In German). From AGF meeting on ground pollution and water pollution: Stocktaking - carryover - redevelopment approaches; Bonn (Germany); 28-29 Nov 1991. In *Soil and water pollution.* Order Number DE93742729. Source: OSTI; NTIS (US Sales Only).

Investigations were carried out with the aim to determine the kinetic parameters of the interaction of heavy metals with and without NTA with kaolinite under the conditions of flowing water. For this, experiments with non-suspended kaolinite in the laboratory scale were carried out as well as running experiments in the technical scale. Furthermore, a mathematical model was developed from these experiments for the description of these processes which allows theoretical predictions. The calculation was carried out for Zinc according to the conditions of the River Rhine, i.e. 250 hours reaction time and the corresponding geometrical as well as chemical parameters like the initial concentration of 230 μg/l Zn in the water. At a concentration of 200 μg/l NTA the calculation predicts an increase of the Zinc concentration in the water of 25 μg/l or of 10%, respectively. (orig./BBR).

6604 (CONF-9111236–, pp. 44-47) **Investigations of isotopes in dissolved organic carbon (DOC). Characterization of DOC and groundwater dating.** Fritz, P. (GSF-Forschungszentrum fuer Umwelt und Gesundheit, Neuherberg (Germany)); Geyer, S.; Wolf, M.; Wassenaar, L.I. Arbeitsgemeinschaft der Grossforschungseinrichtungen (AGF), Bonn (Germany). 1991. 86p. (In German). From AGF meeting on ground pollution and water pollution: Stocktaking - carryover - redevelopment approaches; Bonn (Germany); 28-29 Nov 1991. In *Soil and water pollution.* Order Number DE93742729. Source: OSTI; NTIS (US Sales Only).

Environmental isotope analyses on fractions (humic and fulvic acids) of dissolved organic carbon (DOC) in groundwater document the use of these techniques for the characterisation of DOC in terms of origin, age and geochemical evolution. Especially important is the observation, that age determinations permit a distinction of sedimentary organic carbon fractions from soil-organic-carbon. Ages derived from fulvic acids can be related to their origin in the soil zone and thus the age of a groundwater. This permits verification of both the conventional radiocarbon age determinations of groundwaters as well as the geochemical codes required for their interpretation. First $\delta^{15}N$ and $\delta^{34}S$ determinations on humic and fulvic acids document the potential of such analyses for investigations of transport and geochemical processes which involve DOC. (orig.).

6605 (CONF-9111236–, pp. 8-14) **Balancing heavy metals in the Elbe river.** Fanger, H.U. (GKSS-Forschungszentrum Geesthacht (Germany)); Kappenberg, J.; Kolb, M.; Krueger, A.; Niedergesaess, R.; Penndorf, K.; Prange, A. Arbeitsgemeinschaft der Grossforschungseinrichtungen (AGF), Bonn (Germany). 1991. 86p. (In German). From AGF meeting on ground pollution and water pollution: Stocktaking - carryover - redevelopment approaches; Bonn (Germany); 28-29 Nov 1991. In *Soil and water pollution.* Order Number DE93742729. Source: OSTI; NTIS (US Sales Only).

The tidal region of rivers reaching far upstream of the mouth area, the so called estuary, is of particular interest with respect to the transport of polluted matter to the sea according to the Paris Convention, to sedimentation of contaminated silt in tidal harbours (like Hamburg Harbour), and with respect to turbidity maxima in the mixohaline zone. - The Elbe being the central river in the united Germany, plays an ecologically cumbersome role because of highly polluted loads and, accordingly, considerble toxic and nutrient inputs into the North Sea. Thus, in the context of urgently needed amelioration measures, the determination of the status quo and the improving situation in the waters is an important task. For more than ten years, GKSS is intensely involved in the problems of balancing the fluxes of pollutants (heavy metals) in the tidal Elbe river. - In this contribution, the measuring strategy and major experimental findings that shed some light into the complex processes are reported; the pertaining mathematical-numerical modelling is discussed elsewhere in this volume. (orig.).

6606 (DOE/EA–0562) **Pilot tritium evaporator for the LLNL Site 300 Well 8 Spring environmental assessment.** USDOE, Washington, DC (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93000410. Source: OSTI; NTIS; GPO Dep.

This Environmental Assessment (EA) describes environmental impacts and alternatives for the construction and operation of a pilot ground water evaporator at Lawrence Livermore National Laboratory (LLNL) Site 300 near Building 850. The purpose of the proposed evaporator is to collect data on evaporation as both a specific remedy to evaporator is to collect data on evaporation as both a specific remedy to tritium contamination at this site and a general remedy to low-level tritium contamination at other areas. The evaporator would limit the spread of the contamination at other areas. The evaporator would limit the spread of the tritium plume by preventing the spread of tritium contamination by water from Well 8 Spring. Migration of tritium contaminated ground water from the Building 850 source toward the southern boundary of Site 300 would continue if the ground water is not removed. Data will be collected during both the wet and dry seasons; however, the evaporator is not expected to operate for more than one year.

6607 (DOE/EA–0625-Final-Vol.1) **Subsurface Interim Measures/Interim Remedial Action Plan/Environmental Assessment and Decision Document, Operable Unit No. 2: Volume 1, Text: Final: Environmental Restoration Program.** EG and G Rocky Flats, Inc., Golden, CO (United States). Rocky Flats Plant. 10 Sep 1992. 224p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93002252. Source: OSTI; NTIS; INIS; GPO Dep.

The subject Interim Measures/Interim Remedial Action plan/ Environmental Assessment (IM/IRAP/EA) addresses residual free-phase volatile organic compound (VOC) contamination suspected in the subsurface within an area identified as Operable Unit No. 2 (OU2). This IM/IRAP/EA also addresses radionuclide contamination beneath the 903 Pad at OU2. Although subsurface VOC and radionuclide contamination on represent a source of OU2 groundwater contamination, they pose no immediate threat to public health or the environment. This IM/IRAP/EA identifies and evaluates interim remedial actions for removal of residual free-phase VOC contamination from three different subsurface environments at OU2. The term "residual" refers to the non-aqueous phase contamination remaining in the soil matrix (by capillary force) subsequent to the passage of non-aqueous or free-phase liquid through the subsurface. In addition to the proposed actions, this IM/IRAP/EA presents an assessment of the No Action Alternative. This document also considers an interim remedial action for the removal of radionuclides from beneath the 903 Pad.

6608 (DOE/EA–0625-Final-Vol.2) **Subsurface Interim Measures/Interim Remedial Action Plan/Environmental Assessment and Decision Document, Operable Unit No. 2: Volume 2, Appendices: Final: Environmental Restoration Program.** EG and G Rocky Flats, Inc., Golden, CO (United States). Rocky Flats Plant. 10 Sep 1992. 242p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93002253. Source: OSTI; NTIS; INIS; GPO Dep.

The subject Interim Measures/Interim Remedial Action plan/ Environmental Assessment (IM/IRAP/EA) addresses residual free-phase volatile organic compound (VOC) contamination suspected in the subsurface within an area identified as Operable Unit No. 2 (OU2). This IM/IRAP/EA also addresses radionuclide contamination beneath the 903 Pad at OU2. Although subsurface VOC and radionuclide contamination on represent a source of OU2 groundwater contamination, they pose no immediate threat to public health or the environment. This volume contains five appendices.

6609 (DOE/ER/14262–1) **Solubilization of trace organics in block copolymer micelles for environmental separation using membrane extraction principles: Progress report, May 1, 1992–December 31, 1992.** Hatton, T.A. Massachusetts Inst. of Tech., Cambridge, MA (United States). Dept. of Chemical Engineering. Dec 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER14262. Order Number DE93006000. Source: OSTI; NTIS; GPO Dep.

The solubilization of a range of polycyclic aromatic hydrocarbons in block copolymer micelles has been studied as a function of polymer composition, architecture, and temperature. Micelle formation is favored at high temperatures, leading to significant enhancements in solubilization capacity. At low temperatures, however, micelles do not form and the solubilization capacity of the block copolymer solution for the organics is low; this provides a convenient method for the regeneration of micellar solutions used as "solvents" in the treatment of contaminated feed streams using membrane extraction principles. It has also been shown (in collaboration with K.P. Johnston of University of Texas, Austin) that supercritical CO_2 can be used effectively for micelle regeneration. Theoretical calculations of the structure of block copolymer micelles in the presence and absence of solutes using self-consistent mean-field lattice theories have successfully captured the trends observed with changing polymer composition and architecture, often quantitatively. The temperature and composition dependence of the micellar properties were determined by allowing the individual polymer segments to assume both polar and non-polar conformations.

6610 (DOE/ER/61010–1) **Carbon dioxide, climate and the deep ocean circulation: Carbon chemistry model: Final report.** Menawat, A.S. National Inst. for Global Environmental Change, Davis, CA (United States); Tulane Univ., New Orleans, LA (United States). Dept. of Chemical Engineering. 21 Sep 1992. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC03-90ER61010. Order Number DE93005061. Source: OSTI; NTIS; INIS; GPO Dep.

The objective of this study was to investigate the role of oceanic carbon chemistry in modulating the atmospheric levels of CO_2. It is well known that the oceans are the primary sink of the excess carbon pumped into the atmosphere since the beginning of the industrial period. The suspended particulate and the dissolved organic matters in the deep ocean play important roles as carriers of carbon and other elements critical to the fate of CO_2. In addition, the suspended particulate matter provides sites for oxidation-reduction reactions and microbial activities. The problem is of an intricate system with complex chemical, physical and biological processes. This report describes a methodology to describe the interconversions of different forms of the organic and inorganic nutrients, that may be incorporated in the ocean circulation models. Our approach includes the driving force behind the transfers in addition to balancing the elements. Such thermodynamic considerations of describing the imbalance in the chemical potentials is a new and unique feature of our approach.

6611 (DOE/ER/61029–10) **Continuous measurement of the radon concentration in water using electret ion chamber method.** Dua, S.K. (Clarkson Univ., Potsdam, NY (United States). Dept. of Chemistry); Hopke, P.K.; Kotrappa, P. Clarkson Univ., Potsdam, NY (United States). Dept. of Chemistry. Oct 1992. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER61029. (CONF-920969–2: International symposium on radon and radon reduction technology, Minneapolis, MN (United States), 22-25 Sep 1992). Order Number DE93002248. Source: OSTI; NTIS; INIS; GPO Dep.

A radon concentration of 300 pCi/L has been proposed by the US Environmental Protection Agency as a limit for radon dissolved

in municipal drinking water supplies. There is therefore a need for a continuous monitor to insure that the daily average concentration does not exceed this limit. In order to calibrate the system, varying concentrations of radon in water have been generated by bubbling radon laden air through a dynamic flowthrough water system. The value of steady state concentration of radon in water from this system depends on the concentration of radon in air, the air bubbling rate, and the water flow rate. The measurement system has been designed and tested using a 1 L volume electret ion chamber to determine the radon in water. In this dynamic method, water flows directly through the electret ion chamber. Radon is released to the air and measured with the electret. A flow of air is maintained through the chamber to prevent the build-up of high radon concentrations and too rapid discharge of the electret. It was found that the system worked well when the air flow was induced by the application of suction. The concentration in the water was calculated from the measured concentration in air and water and air flow rates. Preliminary results suggest that the method has sufficient sensitivity to measure concentrations of radon in water with acceptable accuracy and precision.

6612 (DOE/ER/61192–1) **Nutrient availability as a control of the abundance and activities of deep subsurface microorganisms: Final report, June 30, 1991–June 30, 1992.** Ghiorse, W.C. Cornell Univ., Ithaca, NY (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER61192. (CONF-9204213–1: 1. international conference on ground water ecology, Tampa, FL (United States), 26 Apr 1992). Order Number DE93003278. Source: OSTI; NTIS; GPO Dep.

The focus of our research is to determine whether the availability of major nutrients (C, N, P) control the abundance, distribution, and activity of heterotrophic microorganisms in subsurface sediments. Specifically we have developed and are testing a microcosm system using subsurface sediment samples from a DOE site. We are using this system to conduct a preliminary nutrient enrichment experiments. The flow-through microcosm system simulates conditions in natural aquifers and can be regulated with respect to water flow rate, temperature, oxygen concentration, and nutrient concentration. Furthermore, the system cam be run aseptically, excluding exogenous bacteria from test cores. In our preliminary nutrient enrichment experiment, we collected deep vadose sediment from the Savannah River Site and pumped sterilized well water from sampling area through microcosms that were filled with this sediment. Experimental treatments included the flow-through of this water amen with different combinations of nutrients (+N+P, +C, +N+P+C) or no additional nutrients. We found that asepsis was maintained for the entire 30 day experiment. We also found that microbial abundance, biomass, and activity increased in several microcosms in response to the flow through of the well water, which was rich in nitrate. This response, however, was variable among both microcosms containing intact sediments and microcosms containing intact sediment core sections. No significant treatment responses were observed, but each microcosm that had an increase in microbial growth also immobilized N from the well water. We infer that water and N availability, and water table fluctuations strongly influence microbial growth and activity in the deep vadose.

6613 (DOE/ER/61443–1) **Development of a multi-sensor in situ fiber optic fluorometer: Progress report, June 1, 1992–December 31, 1992.** Lohrenz, S.E. (University of Southern Mississippi, Stennis Space Center, MS (United States). Center for Marine Sciences); Asper, V.L.; Morris, M.J.; Walters, R.A. University of Southern Mississippi, Stennis Space Center, MS (United States); Ocean Optics, Inc., Dunedin, FL (United States). Dec 1992. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER61443. Order Number DE93004646. Source: OSTI; NTIS; GPO Dep.

Objective is to develop and evaluate a multi-sensor in situ fiber optic fluorometer. The instrument is designed to sample and store in vivo strobe-stimulated fluorescence data at multiple depths and high frequencies (1 Hz). This information may be used for estimating the distribution and abundance of particulate pigment biomass, for supporting models of water column primary production and as a complement to remotely sensed ocean color estimates of pigment biomass. The instrument is unique in that it uses fiber optic technology to increase vertical resolution. While it is theoretically possible to accomplish this task using a large number of commercially available fluorometers, our proposed design would provide a less expensive approach. A laboratory prototype has been built and is being tested. Preliminary results indicate that the instrument meets all the project goals and that low cost, high frequency, high spatial resolution chlorophyll data are obtainable with the current design. Further work is required to develop the seagoing version, and optimize the configuration of the fiber sensors.

6614 (DOE/RL–92-26-2) **Quarterly report of RCRA groundwater monitoring data for period April 1, 1992–June 30, 1992.** Westinghouse Hanford Co., Richland, WA (United States). Geosciences Group. Oct 1992. 455p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93002250. Source: OSTI; NTIS; INIS; GPO Dep.

Hanford Site interim-status groundwater monitoring projects are conducted as either background, indicator parameter evaluation, or groundwater quality assessment monitoring programs as defined in the Resource Conservation and Recovery Act of 1976 (RCRA); and 40 CFR 265, Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities, as amended (EPA 1991a). Compliance with the 40 CFR 265 regulations is required by the Washington Administrative Code (WAC) 173-303 (Ecology 1991). This report contains data from Hanford Site groundwater monitoring projects.

6615 (DOE/SR/15160–5) **Hydrogeologic investigation and establishment of a permanent multi- observational well network in Aiken, Allendale, and Barnwell counties, South Carolina: Phase 5.** Simones, G.C. South Carolina Water Resources Commission, Columbia, SC (United States). Sep 1992. 61p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC09-86SR15160. (OFR–41). Order Number DE93004305. Source: OSTI; NTIS; GPO Dep.

The Lower Savannah River Project was established in 1986 to enhance understanding of hydrogeologic conditions in and around the Savannah River Site. Four phase reports have been produced since 1987. This phase report covers one year and eleven months of activity from August 1990 through June 1992. Five monitor wells were installed at site C-3 and four at C-5 to complete these clusters. A total of 3,014 feet were drilled to complete these nine monitor wells. New geophysical logs were made at sites C-3 and C-5 to replace earlier, incomplete versions. Hydraulic-head relationships and stratigraphy have been determined for sites C-3 and C-5. Twenty-eight monitor wells are distributed among the five cluster sites (C-2, C-3, C-5, C-6, and C-10). Pumps were installed in 26 wells, and water samples from these wells were analyzed to determine the chemical composition. sieve analyses were made for 296 sediment samples taken from five core holes. Cumulative curves were prepared for samples taken from the screened zone of each monitor well. Core-description information from five sites has been entered into dbase files for use in statistical analyses.

6616 (GSF–11/92) **Ecological and chemical investigations for assessing the environmental pollution level of the new German Laender. Pt. 4. Volatile halogenated hydrocarbons.** Heinisch, E. (Institut fuer Oekosystemforschung Berlin-Halle, Berlin (Germany). Oekologisch-Chemische Forschungslaboratorien); Klein, S.; Schaffer, P.; Kettrup, A.; Loerinci, G.; Steinberg, C. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany). Apr 1992. 125p. (In German). Order Number DE93742862. Source: OSTI; NTIS (US Sales Only).

Volatile halogenated hydrocarbons, if for nothing but their volume, have a key role in organic synthesis chemistry. There are about 30 chlorine-substituted, bromine-substituted, fluorine-substituted and mixed-substituted methanes, ethanes, ethenes and propanes of ecochemical and ecotoxicological interest. The investigation concentrated on haloforms and some chlorinated solvents. Data were collected on the production of selected volatile hydrocarbons, emissions and immissions directly related to the production sphere, and the resulting concentrations in the environment of the former GDR. After presenting physical-chemical and toxicological data and limiting values of the substances of interest, the authors bring forward the findings of their own studies on volatile

halogenated hydrocarbons in bodies of surface water in the Berlin-Potsdam region. These are supplemented by data of other East German regions, provided by various East German hygiene institutions, and data from the relevant literature. (orig./BBR).

6617 (IAEA-R–5179-F) **14C dating of freshwater carbonate sediments with special reference to calcareous tufas and laminated lake sediments: Final report for the period 1 October 1988 - 15 November 1991.** Pazdur, M.F. (Uniwersytet Slaski, Katowice (Poland). Inst. Fizyki). International Atomic Energy Agency, Vienna (Austria). Sep 1992. [62] Order Number DE93609097. Source: OSTI; NTIS (US Sales Only); INIS.

The sequence of laminated sediment of the lake Gosciaz, Poland, covers more than 13,000 years and is actually the longest sequence known so far. Besides of reconstructing past environmental changes, this sequence offers an excellent possibility for studying natural C-14 variations and calibrating the C-14 time scale in a range beyond 6,000 years B.P. The floating varve chronology based on previously taken sediment cores which cover a period of 9,682 years, has been improved by this study. Relative water level changes of the lake during the past 11,500 years have been reconstructed by means of C-14 and C-13 measurements carried out on carbonate fractions of the lake sediments. Periodical variations in the width of annual layers were found. The periods identified are 11 years and 22 years (solar cycle), 35 years (Bruckner cycle), and 200 years. The ratio of summer layer width and the total width of the annual layer shows secular changes which correlate with paleotemperature records. The duration of the Younger Dryas period was determined by combining the floating varve chronology with isotope and pollen analyses of the sediment material. A value of 1,500 years was found. The study also included radiocarbon dating of calcareous tufa taken from different study areas. 26 refs, 26 figs, 6 tabs.

6618 (INPE–2361) **Study of sea surface temperature distribution, in Angra dos Reis Nuclear Plant region - Mission Angra 01.** Stevenson, M.R.; Steffen, C.A.; Villagra, H.M.I. Instituto de Pesquisas Espaciais (INPE), Sao Jose dos Campos, SP (Brazil). Mar 1982. [31] (In Portuguese). (RA–160.). Order Number DE93609099. Source: OSTI; NTIS (US Sales Only); INIS.

A study of spectral and temporal variations of sea surface temperature, using data obtained from level of satellite, aircraft and surface, with the purpose of evaluate and plot the small scale variations of sea surface temperature, due to thermal discharge from a nuclear the results of the first mission called Angra 1. (maps). (C.G.C.).

6619 (LBL–32662) **Analysis of the potential impacts on surface water quality resulting from the proposed use of the San Luis Drain to transport agricultural drainage through the northern Grasslands.** Quinn, N.W.T. Lawrence Berkeley Lab., CA (United States). May 1992. 243p. Sponsored by Department of the Interior, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE93001538. Source: OSTI; NTIS; GPO Dep.

An Environmental Assessment and initial Study for the interim use of a portion of the San Luis Drain for conveyance water through the Grassland Water District and adjacent Grassland areas was conducted. The project proposes the use of 18 miles of the San Luis Drain for the conveyance of agricultural drainage water for a period of five years and the elimination of agricultural drainage discharges from 76 miles of existing channels in and adjacent to the Grassland Water District. A report was prepared to (a) quantify the potential project effects on surface water quality within Salt and Mud Sloughs and the San Joaquin River using currently available data, and (b) to improve the understanding of existing water supply and drainage operations within the Grassland area. After submission of the original report it was brought to the attention of one of the coauthors that the database on selenium and boron concentrations in drainage water did not include the water quality data collected by the Regional Water Quality Control Board (CRWQCB). In addition, the US Bureau of Reclamation (USBR) requested further examination of Grasslands hydrology to estimate the quantity of supplemental water that would be needed to restore the San Joaquin River to the same TDS and trace element concentrations prior to implementation of the project. This report addresses these issues.

6620 (LITH-MAT-R–92-32) **Statistical extrapolation of nutrient concentrations in the Baltic Sea.** Nordgaard, A.; Hjorth, U. Linkoeping Univ. (Sweden). Dept. of Mathematics. Jun 1992. 62p. Order Number DE93753076. Source: OSTI; NTIS.

In this paper we present some methods for doing extrapolation of nutrient concentrations in the water mass of the Baltic Sea. One purpose is to make summations of the total amounts of nutrients in different basins. Data are modelled as observations from a stochastic process having room coordinates as its parameter. Three methods of extrapolation are deduced and the choice of method is based on validation towards the current data set.

6621 (ORNL/ER–139) **Toxicological benchmark for screening of potential contaminants of concern for effects on aquatic biota on the Oak Ridge Reservation, Oak Ridge, Tennessee: Environmental Restoration Program.** Suter, G.W. II; Futrell, M.A.; Kerchner, G.A. Oak Ridge National Lab., TN (United States). Environmental Restoration Div. Sep 1992. 86p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93000719. Source: OSTI; NTIS; INIS; GPO Dep.

Environmental Sciences Division Publication 3940.

One of the initial stages in ecological risk assessment of hazardous waste sites is the screening of contaminants to determine which of them are worthy of further consideration. This report presents potential screening benchmarks for protection of aquatic life from contaminants in water. Because there is no guidance for screening benchmarks, a set of alternative benchmarks is presented here. The alternative benchmarks are based on different conceptual approaches to estimating concentrations causing significant effects. To the extent that toxicity data are available, this report presents the alternative benchmarks for chemicals that have been detected on the Oak Ridge Reservation. It also presents the data used to calculate the benchmarks, and the sources of the data. It compares the benchmarks and discusses their relative conservatism and utility.

6622 (SA-PUB–3/92, pp. 27-32) **Evaluation of changes in hydrological time series.** Hiltunen, T. (National Board of Waters and the Environment, Helsinki (Finland). Hydrological Office); Hyvaerinen, V. Academy of Finland, Helsinki (Finland). 1992. In *The Finnish research programme on climate change: Progress report.* 310p. Order Number DE93752870. Source: OSTI; NTIS.

SILMU Research Programme.

The weather affects all of the earth's water circulation processes. Observations of some of the phenomena of importance have long been made, as in the case, for example, of freezing and ice break up. Observations of certain parameters requiring quantitative measurements were started later, e.g. precipitation and discharge. In contrast, registers of parameters more difficult to record, such as the water equivalent of snow, ground water level, frost, soil moisture and evaporation, have been carried out only over the past 20 to 40 years. Five reliable discharge time series have also been obtained analysis from Estonia, and six discharge time series from St. Petersburg area. Sweden and northern Norway are still worth comparing with. Only six Finnish series have been analyzed at this point. The annual precipitation has been studied in a separate SILMU project. From the researcher's point of view, time series are nearly always too short. This is due to difficulties in distinguishing between long-term variations and trends; there is no completely watertight method. Help can nevertheless be found in distinguishing between causes and mechanisms. Although long-term homogenic time series are in the minority, they do allow for the possibility of: researching the properties of runoff in the past by analyzing short and long-term variations and trends, analyzing changes in seasonal variations, establishing climatic causes for changes and comparing developments in surrounding areas - throughout Finland, Scandinavia, the Baltic countries, etc.; predicting changes in discharge in the near future according to various climatic change scenarios. At the moment, work is being carried out on establishing homogeneity, as well as the choice of the methods.

6623 (SA-PUB–3/92, pp. 33) **The present stage of hydrometeorological part of the SILMU-project.** Solantie, R. (Finnish Meteorological Inst., Helsinki (Finland)). Academy of Finland, Helsinki (Finland). 1992. In *The Finnish research programme on climate change: Progress report.* 310p. Order Number DE93752870. Source: OSTI; NTIS.

SILMU Research Programme.

Short communication. RAIN/mathematical models; HYDROLOGY; RAIN WATER; DATA; SNOW; CLIMATIC CHANGE; FINLAND; RAIN; RESEARCH PROGRAMS

6624 (SA-PUB–3/92, pp. 101-108) **The effect of climate change on the hydrology and material fluxes of forested catchments.** Kaemaeri, J. (Water and Environment Research Institute, Helsinki (Finland)); Seuna, P.; Ahlberg, T.; Holmberg, M.; Kivinen, Y.; Lepistoe, A.; Roos, J.; Soveri, J. Academy of Finland, Helsinki (Finland). 1992. In *The Finnish research programme on climate change: Progress report.* 310p. Order Number DE93752870. Source: OSTI; NTIS.

SILMU Research Programme.

The purpose of the present project is to study the impacts of possible climate change on the material fluxes in forested catchments. The research project has two objectives. First we study the hydrological processes in the catchments, the age and the flow paths of the runoff, the interrelationships between flow patterns and water quality, as well as the internal mass balances in the catchments. Secondly a mathematical simulation model incorporating descriptions of the most important hydrological and chemical processes are developed. The study requires intensive hydrological and physico-chemical data. The collection of the empirical data used as the basis of the mass balance calculations as well as of the predictions by the model being developed are described in this report. The preliminary results given in the paper are intended to demonstrate the later use of the data.

6625 (SA-PUB–3/92, pp. 109-114) **Effect of climatic change on the temperature of lakes.** Virta, J. (Helsinki Univ. (Finland). Dept. of Geophysics); Elo, A.R.; Pulkkinen, K. Academy of Finland, Helsinki (Finland). 1992. In *The Finnish research programme on climate change: Progress report.* 310p. Order Number DE93752870. Source: OSTI; NTIS.

SILMU Research Programme.

Physical quantities in a lake such as temperature, mixing, waves, solid matter concentration and currents are mainly dependent on the direct influence of the atmosphere. Changes in catchment also effect these quantities. As almost all processes are interrelated, changes in physical quantities may influence changes in whole ecosystem of a lake. Temperature is relatively easy to measure, it varies relatively slowly and it is possible to determine factors which influence it. It is possible to describe temperature with relatively good models based on physical information. Input data for these models can be obtained from meteorological variables whose change due to the climatic change can be estimated. The temperature of a lake has a direct connection with biological processes, vertical mixing and the timing of ice formation and ice break up. There exist long duration data on the last mentioned times, and these have been shown to be very good indicators of changes of the climate. In this study the reliability of the temperature model and its ability to describe temperature in the hypolimnion was illustrated. It was seen that the model gave good results for the temperature of the epilimnion, but results were poor for the hypolimnion. For this reason it is not possible temperature of Paeaejaervi before the temperature model for the hypolimnion is ready.

6626 (SA-PUB–3/92, pp. 115-119) **Effects of climate change on fishes, fish stocks, fisheries and aquaculture.** Lehtonen, H. (Finnish Game and Fisheries Research Institute, Helsinki (Finland)); Lappalainen, J.; Forsman, L. Academy of Finland, Helsinki (Finland). 1992. In *The Finnish research programme on climate change: Progress report.* 310p. Order Number DE93752870. Source: OSTI; NTIS.

SILMU Research Programme.

Many fish species in Finland live in extreme conditions at the limits of their distribution, suggesting that small changes in climate may also have large effects on distribution areas. For example, when the climate became slightly colder in the 1940s- 1960s many pikeperch populations weakened or even collapsed in the lakes of central and northern Finland. Expected changes are, however much faster than those which have occurred recently. Thus, the changes in fish stocks can be expected to be extensive. This paper, based on a literature review, is a preliminary study of the effects of climate change on fishes, fish stocks and aquaculture.

6627 (SA-PUB–3/92, pp. 120-125) **Impact of climate change on carbon cycle in freshwater ecosystems.** Arvola, L. (Oulanka Biological Station, Kuusamo (Finland)); Kankaala, P.; Ojala, A. Academy of Finland, Helsinki (Finland). 1992. In *The Finnish research programme on climate change: Progress report.* 310p. Order Number DE93752870. Source: OSTI; NTIS.

SILMU Research Programme.

The aim of this study is to produce a carbon cycle model which could be used for predicting the impact of climate change on structure and functioning of food webs in lake ecosystems. The emphasis is mainly directed to changes in the pelagic system in conditions where: Due to the changes in the drainage area (e.g. the vegetative period will be longer, the ground will be frozen only for a short period, the precipitation will increase especially in winter) discharge and leaching of nutrients and organic compounds will increase. The ice-free period will last for 9-12 months compared to the present length of 7 months. The studies are carried out in lake Paeaejaervi in southern Finland, of which hydrology and ecology have been studied since the 1960's. These previous results and the water-quality data by the National Board of Waters and Environment have been used to estimate the changes which have occurred in the lake during the last two decades. The results of this project will be compared with the paleolimnological studies of SILMU in order to reveal the long-term changes in the lake in different climatic conditions. In 1990 and 1991 the following questions have been studied: Changes in loading, water quality structure and productivity of the pelagic ecosystem of lake Paeaejaervi during the last 25 years and how these changes are related to change in weather conditions and/or climate; Changes in the structure of the food web and carbon cycle at different times of the year if the loading of organic matter and nutrients increases and Physical, chemical and biological factors controlling the metabolism of different compartments of the food web.

6628 (SA-PUB–3/92, pp. 126-131) **Effect of climatic change, air pollutants and land use on lake ecosystems.** Kauppi, L. (National Board of Waters and the Environment, Helsinki (Finland)); Forsius, M.; Posch, M.; Kaemaeri, J.; Kallio, K.; Frisk, T.; Huttula, T.; Bilaletdin, Ae. Academy of Finland, Helsinki (Finland). 1992. In *The Finnish research programme on climate change: Progress report.* 310p. Order Number DE93752870. Source: OSTI; NTIS.

SILMU Research Programme.

Changes in the composition of the atmosphere and consequent global climate change will have a profound impact on the structure and function of both terrestrial and lacustrine ecosystems. In addition to the direct effects of wastewater loadings and atmospheric deposition, lake ecosystems are affected by diverse human activities in the drainage basins. Therefore, possible changes in soils and vegetation are directly reflected also in the lake ecosystems. The importance of the terrestrial catchments has clearly been noticed also in the development of lake models, particularly in acidification research. The most important processes, which have to be considered in the evaluation of potential climate change effects on lake ecosystems concern changes in input flutes, changes in physical lake properties, and chemical changes in lakewater quality. All these changes then obviously affect also the lake biota. In agricultural basins the increase in runoff, may increase the leaching of nutrients to the lakes hence accelerating eutrophication. In acid-sensitive forested catchments the increased mineralization of nitrogen may dramatically alter nitrate leaching thus causing acidification of soils and surface waters. The aim of the present study is to quantitatively assess the possible climate change effects on hydrological, chemical and biological properties of lakes affected by different kinds of human activities, such as agriculture, forestry, and acidic deposition. Mathematical models are applied and developed, mostly utilizing data collected in other research projects. The

modelling work is done in close co-operation with the SILMU catchment-projects, which supply the lake models with leaching data.

6629 (SA-PUB–3/92, pp. 132-137) **Effects of the climate change on the hydrography of the Baltic Sea.** Alenius, P. (Finnish Institute of Marine Research, Helsinki (Finland)); Haapala, J. Academy of Finland, Helsinki (Finland). 1992. In *The Finnish research programme on climate change: Progress report.* 310p. Order Number DE93752870. Source: OSTI; NTIS.

SILMU Research Programme.

The Baltic Sea is the largest brackish water basin in the world. Its ecology is specific with both marine and fresh water species. Its biology is strongly dependent on the salinity conditions. Due to its physical nature the Baltic Sea can react strongly to climate change. Climatic change can alter the water exchange and river runoff, and thus modify the water balance. This then changes the salinity conditions and stratification. Warming up of the climate can also change the stratification of the Baltic Sea. Temperature and salinity of the Baltic Sea have been regularly measured by the Finnish Institute of Marine Research (FIMR) and its predecessors since 1898. The data sets consist of both open sea data from research cruises and coastal data from fixed oceanographic stations. Some of those time series have already been used earlier in climatic studies. The first aim of our project was to convert all the relevant data sets of the FIMR into corrected computerized form. We then analyzed typical hydrographic features of the Baltic Sea and changes in them during this century. The third stage of the project will be numerical modelling of the hydrographic conditions.

6630 (SVF–434) **Application of membrane technology for the treatment of process water in power stations.** Falk, I. (Studsvik Material AB, Nykoeping (Sweden)); Svensson, J. Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden); Studsvik AB, Nykoeping (Sweden). Materials. May 1992. 68p. (In Swedish). (STUDSVIK-M–92-14). Order Number DE93753063. Source: OSTI; NTIS.

A review has been carried out of experience gained from industrial applications of membrane technology and the status of technical developments in this field, in order to evaluate the usefulness of this method for the treatment of process water at power plants. The review shows that membranes are used for the purification of turbine condensate in BWR stations in Japan. The iron content in the condensate is reduced from c 30 ppb to <0.1 ppb, and the equipment has functioned excellently for 4 years. At PWR stations, both ultra-filtrations (UF) and reverse osmosis (RO) are used for purification and the recovery of boric acid. The filtration gives cleaner effluent and lower costs for the low-level wastes. In order to comply with stringent environmental requirements as regards the release of chemical substances from cellulose production, UF filters are used in the purification of bleaching effluent in Japan. The plant began operating in 1980 and has resulted in a considerably improved reduction of the chemical oxygen consumption by the waste water. Recently, a filter with an UF membrane for the treatment of bleaching effluent has been taken into use in Husum, Sweden. The same type of filter (CR) is used for the treatment of backwater at the board factory in Svanskog, Sweden. In view of the increased development of new membranes, and the experimental work with pilot plants test that has been described in many cases during recent years (1989-90), it is possible to predict a greatly increased use of membrane technology for process water and waste water. (au) (60 refs., 17 figs., 5 tabs., 12 apps.).

6631 (WSRC-RP–92-239) **A comparison of ROChem reverse osmosis and spiral wound reverse osmosis membrane modules.** Siler, J.L. Westinghouse Savannah River Co., Aiken, SC (United States). 31 Jan 1992. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93002806. Source: OSTI; NTIS; INIS; GPO Dep.

Testing of the ROChem Disc Tube® reverse osmosis (RO) module's performance on biologically active feed waters has been completed. Both the ROChem module (using Filmtec standard-rejection seawater membranes) and the Filmtec spiral-wound membrane module (using Filmtec high-rejection seawater membranes) were tested with stimulant solutions containing typical bacteria and metal hydroxide levels found in the F/H Effluent Treatment Facility (ETF) influent. Results indicate that the ROChem module gave superior performance over the spiral-wound module. Water flux losses were reduced by over 30% for water recoveries above 40%.

55 BIOMEDICAL SCIENCES, BASIC STUDIES

5501 Behavioral Biology

Refer also to citation(s) 6711

5502 Biochemistry

Refer also to citation(s) 5235, 5238, 6637, 6638, 6639, 6640, 6668, 6723

6632 (ANL/BIM/CP–76001) **Rearrangement of Rag-1 recombinase gene in DNA-repair deficient/immunodeficient "wasted" mice.** Woloschak, G.E. (Argonne National Lab., IL (United States)); Weaver, P.; Churchill, M.; Chang-Liu, C-M.; Libertin, C.R. Argonne National Lab., IL (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9208179–1: 7. international congress of mucosal immunology, Prague (Czechoslovakia), 16-20 Aug 1992). Order Number DE93003003. Source: OSTI; NTIS; GPO Dep.

Mice recessive for the autosomal gene "wasted" (wst) display a disease pattern which includes increased sensitivity to the killing effects of ionizing radiation, immunodeficiency, and neurologic dysfunction. The recent cloning and characterization of recombinase genes (Rag-I/Rag-2) expressed in lymphoid and possibly central nervous system tissues prompted us to examine expression of these genes in DNA repair-deficient/immunodeficient wasted mice. Our results revealed that in thymus tissue, a small Rag-I transcript (1.0 kb) was detected in wst/wst mice that was not evident in thymus from control mice. In wst/• mice, a two-fold increase in Rag-1 mRNA was evident in thymus tissue. Rag-2 mRNA could only be detected in thymus tissue from wst/• and not from wst/wst or parental control BCF, mice. Southern blots revealed a rearrangement or deletion within the Rag-1 gene of affected wasted mice that was not evident in known strain-specific parental or littermate controls. These results support the idea that the Rag-1 gene may map at or near the locus for the wasted mutation. In addition, they suggest the importance of recombinase function in normal immune and central nervous system development as well as the potential contribution of this gene family to the normal repair of radiation-induced DNA damage.

6633 (DOE/ER/20028–T2) **A genetic analysis of Adhl regulation: Progress report, June 1991–May 1993.** Freeling, M. California Univ., Berkeley, CA (United States). Dept. of Plant Biology. [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-91ER20028. Order Number DE93004901. Source: OSTI; NTIS; GPO Dep.

Several separate but related studies are reported on the mechanism of alcohol dehydrogenase (Adh-1) are reported. A study of a deletion mutation in the TATA box region which resulted in an increase from 6–60% of wildtype Adh-1 expression in the revertant has led to a focus on trans-acting protein factors that bind the TATA box. Analysis of another revertant has led to study of cis-acting sequences in Adh-1 expression. Screening efforts aimed at defining different mutants affecting Adh-1 expression are reported.

6634 (DOE/ER/20050–1) **Role of Ca^{++}/calmodulin in the regulation of microtubules in higher plants: Progress report, FY91.** Cyr, R. Pennsylvania State Univ., University Park, PA (United States). [1991]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER20050. Order Number DE93005999. Source: OSTI; NTIS; GPO Dep.

This work is aimed at defining the role of calcium/calmodulin in regulating cortical microtubules (MTS) in higher plants. Recent

thrust has been to define the effects of calcium upon microtubules in vivo. Using lysed protoplasts, we noted Mts are destabilized by calcium/calmodulin. This effect could be the result of gross depolymerization induced by Ca^{++}/calmodulin, or by an increase in the dynamic flux rate. Intact protoplasts exposed to high (10 mM) levels of calcium (which would be expected to increase intercellular calcium levels) contained microtubules that were hypersensitive to Mt inhibitors, compared to control protoplasts exposed to low calcium environments.

6635 (DOE/ER/60688–5) **[Characterization and modification of phage T7 DNA polymerase for use in DNA sequencing]: Progress report.** Harvard Medical School, Boston, MA (United States). Dept. of Biological Chemistry and Molecular Pharmacology. [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER60688. Order Number DE93006149. Source: OSTI; NTIS; GPO Dep.

This project focuses on the DNA polymerase and accessory proteins of phage T7 for use in DNA sequence analysis. T7 DNA polymerase (gene 5 protein) interacts with accessory proteins for the acquisition of properties such as processivity that are necessary for DNA replication. One goal is to understand these interactions in order to modify the proteins to increase their usefulness with DNA sequence analysis. Using a genetically modified gene 5 protein lacking 3' to 5' exonuclease activity we have found that in the presence of manganese there is no discrimination against dideoxynucleotides, a property that enables novel approaches to DNA sequencing using automated technology. Pyrophosphorolysis can create problems in DNA sequence determination, a problem that can be eliminated by the addition of pyrophosphatase. Crystals of the gene 5 protein/thioredoxin complex have now been obtained and X-ray diffraction analysis will be undertaken once their quality has been improved. Amino acid changes in gene 5 protein have been identified that alter its interaction with thioredoxin. Characterization of these proteins should help determine how thioredoxin confers processivity on polymerization. We have characterized the 17 DNA binding protein, the gene 2.5 protein, and shown that it interacts with gene 5 protein and gene 4 protein. The gene 2.5 protein mediates homologous base pairing and strand uptake. Gene 5.5 protein interacts with E. coli HI protein and affects gene expression. Biochemical and genetic studies on the T7 56-kDa gene 4 protein, the helicase, are focused on its physical interaction with T7 DNA polymerase and the mechanism by which the hydrolysis of nucleoside triphosphates fuels its unidirectional translocation on DNA.

6636 (LBL–32809) **Studies of DNA supercoiling in vivo and in vitro.** Cook, D.N. Lawrence Berkeley Lab., CA (United States). Oct 1990. 239p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE93002556. Source: OSTI; NTIS; GPO Dep.

This thesis describes a number of diverse experiments whose common theme is to elaborate some aspect of DNA supercoiling. The torsion elastic constant of DNA is measure as a function of superhelix density using the technique of picosecond Time Resolved Fluorescence Polarization Anisotropy (FPA) of intercalated ethidium bromide. The results agree with theories which predict that the anisotropy decay should vary with the square root of the relative viscosity. This experiment furthermore demonstrates a sensitivity of FPA to a change in torsion elastic constant of less than 10%. A number of covalently closed DNA samples, ranging in superhelix density from = −0.123 to +0.042, are then examined. A novel method for measuring changes in local supercoiling on a large PNA molecule which is sensitive to changes in supercoiling of regions of chromosomal DNA as short as 1 kilobase in length is presented. Study of chromosomal supercoiling regulating anaerobic gene expression in the facultative photosynthetic bacterium, Rhodobacter capsulatus showed that no stable change in chromosomal supercoiling upon a shift from aerobic respiratory growth to anaerobic photosynthetic conditions. Studies to detect transient changes in DNA supercoiling indicate that DNA downstream from heavily transcribed genes for the photosynthetic reaction center are relaxed or perhaps overwound upon the induction of photosynthetic metabolism. These results are interpreted in terms of the twin domain model of transcriptional supercoiling.

5503 Cytology

Refer also to citation(s) 6784, 6785

5504 Genetics

Refer also to citation(s) 6555, 6633, 6635

6637 (ANL/BIM/CP–75997) **SBH and the integration of complementary approaches in the mapping, sequencing, and understanding of complex genomes.** Drmanac, R.; Drmanac, S.; Labat, I.; Vicentic, A.; Gemmell, A.; Stavropoulos, N.; Jarvis, J. Argonne National Lab., IL (United States). [1992]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9206273–2: 2. international conference on bioinformatics, supercomputing, and complex genome analysis, St. Petersburg, FL (United States), 4-7 Jun 1992). Order Number DE93004196. Source: OSTI; NTIS; INIS; GPO Dep.

A variant of sequencing by hybridization (SBH) is being developed with a potential to inexpensively determine up to 100 million base pairs per year. The method comprises (1) arraying short clones in 864-well plates; (2) growth of the M13 clones or PCR of the inserts; (3) automated spotting of DNAs by corresponding pin-arrays; (4) hybridization of dotted samples with 200-3000 ^{32}P- or ^{33}P-labeled 6- to 8-mer probes; and (5) scoring hybridization signals using storage phosphor plates. Some 200 7- to 8-mers can provide an inventory of the genes if CDNA clones are hybridized, or can define the order of 2-kb genomic clones, creating physical and structural maps with 100-bp resolution; the distribution of G+C, LINEs, SINEs, and gene families would be revealed. cDNAs that represent new genes and genomic clones in regions of interest selected by SBH can be sequenced by a gel method. Uniformly distributed clones from the previous step will be hybridized with 2000–3000 6- to 8-mers. As a result, approximately 50–60% of the genomic regions containing members of large repetitive and gene families and those families represented in GenBank would be completely sequenced. In the less redundant regions, every base pair is expected to be read with 3-4 probes, but the complete sequence can not be reconstructed. Such partial sequences allow the inference of similarity and the recognition of coding, regulatory, and repetitive sequences, as well as study of the evolutionary processes all the way up to the species delineation.

6638 (CONF-9209255–Absts.) **First International E. coli genome meeting.** Wisconsin Univ., Madison, WI (United States). Dept. of Biochemistry. [1992]. 29p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER61504. From 1. international E. Coli Genome meeting; Madison, WI (United States); 10-14 Sep 1992. Order Number DE93002367. Source: OSTI; NTIS; GPO Dep.

This volume is a collection of abstracts of oral presentations and poster sessions of studies reported at the First International E. Coli Genome Meeting, held September 10-14, 1992 at the University of Wisconsin.

6639 (DOE/ER/60691–1) **Robust detailed mapping of the human genome.** Lerman, L.S. Massachusetts Inst. of Tech., Cambridge, MA (United States). [1992]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER60691. Order Number DE93006081. Source: OSTI; NTIS; GPO Dep.

The project aimed to develop a procedure for mapping genomic sequences based on principles and markers different from those invoked in conventional restriction site-based mapping. The primary markers are to be regions of about 50 to 300bp with thermal stability (the temperature required for disordering of the helix) that is significantly lower than the stability of the adjacent segments and also regions of particularly high thermal stability. Sequence-tagged-sites and other segments of known sequence and restriction sites serve as secondary markers to preserve complete compatibility with conventional mapping. In principle, the procedure is technically simple and generally applicable, useful for both uncloned genomic DNA and for clones of large segments, such as yeast artificial chromosomes. Because cloning would not be essential, because the system is not sensitive to variation of one or a few bases

(which can alter restriction sites), and because it will specifically locate CpG⁻ island, it was expected to have significant advantages as a complement to conventional mapping methods.

6640 (DOE/ER/61245–1) **Identification of transcribed sequences in the human genome: Final report, September 15, 1991–September 14, 1992.** Gardiner, K. Eleanor Roosevelt Inst., Denver, CO (United States). Dec 1992. 38p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER61245. (CONF-9110446–Absts.: 1. international workshop on the identification of transcribed swquences in the human genome, Bethesda, MD (United States), 4-5 Oct 1991). Order Number DE93005046. Source: OSTI; NTIS; GPO Dep.

The workshop was held at the National Institutes of Mental Health, Bethesda, Maryland, on October 4 and 5, 1991. Twenty-four investigators attended from England, Germany and the United States. The topics discussed included: Genome sequence analysis using computer assisted detection of open reading frames, splice sites and hexamer patterns, direct exon identification using trapping of internal and 3' exons, and a recombination based system, cDNA library construction and screening, including the use of normalization and subtraction procedures, Alu and splice donor site PCR from hybrid cell lines, and microdissection clones as probes, use of labeled CDNAS as probes to screen lambda and cosmid libraries, and sequencing of random cDNAs.

5506 Medicine

6641 (BNL–48016) **Compton-backscattering x-ray source for coronary angiography.** Blumberg, L.N. Brookhaven National Lab., Upton, NY (United States). [1992]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-921116–13: 12. international conference on the application of accelerators in research and industry, Denton, TX (United States), 2-5 Nov 1992). Order Number DE93003473. Source: OSTI; NTIS; GPO Dep.

An X-ray source utilizing Compton-backscattered (CB) photons in a 75-MeV electron storage ring containing an infrared FEL is proposed for producing 33.17-keV X-rays (Iodine K-edge) for coronary angiography. The X-ray intensity into a 4-mrad cone is computed as 7.21×10^{14}/sec for a 500-mA electron beam colliding with 0.2-J/bunch, 3.22-μm photons from an in-ring IR-FEL at the 353.21-MHz rate of a SLAC-PEP 500-kW RF system. The resultant average flux at the patient is 6.4×10^{7} photons/pixel/4-msec aver a 12-cm diameter circle at 3-m from the interaction point for the 0.5 $\times$0.5-mm^2 pixel size of the present Si(Li) array of the BNL-SMERF Angiography Facility. This flux is 2.1 times larger than obtains at SMERF at a comparable source-to-patient distance and over an area sufficient to encompass the entire coronary region. However, the X-Ray energy spread due to kinematics alone is 2.63-keV, a factor of 35 larger then SMERF, and presents the major difficulty for the digital subtraction angiography method (DSA) envisioned.

6642 (DOE/ER/60401–3) **Radiolabeled androgens and progestins as imaging agents for tumors of the prostate and breast: Technical progress report, February 1, 1992–January 31, 1993.** Katzenellenbogen, J.A. Illinois Univ., Urbana, IL (United States). 8 Aug 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-86ER60401. Order Number DE93006145. Source: OSTI; NTIS; GPO Dep.

We are preparing progestins and androgens, labeled with the single photon emitters technetium-99m and rhenium-186 and the positron-emitting radionuclide fluorine-18. In both cases, ligands selected have very high affinity for the respective receptor, low affinity for blood and non-specific binders and to be reasonably resistant to metabolism: The progestins will be derivatives of the potent progestins ORG2058, norgestrel, RU486, and an unusual retroprogestin and the androgens will be derivatives of the high affinity analogs of natural and synthetic androgens. Radiometal labeling will involve carefully designed steroid conjugates with N_2S_2 or related chelates, or novel metal linkages, and metal complexes that themselves mimic a steroid. Fluorine substitution will be made at positions where bulk and polarity are tolerated and metabolic defluorination is minimal. In vitro competitive binding studies will be performed on the unlabeled analogs to determine their binding characteristics towards a series of steroid receptors and blood binding proteins, and Log P values will be estimated from BPLC. Tissue distribution studies with the radiolabeled progestins will be done in estrogen-primed rats using the uterus as a target, and with the radioandrogens in estrogen-treated rats using the prostate as a target. Ultimately, in collaborative studies, these radiopharmaceuticals are to be used with SPECT or PET to image the receptor-positive tumors.

6643 (EGG-BNCT–10016-05/06) **INEL BNCT Research Program, May/June 1992.** Venhuizen, J.R. EG and G Idaho, Inc., Idaho Falls, ID (United States). Sep 1992. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93003686. Source: OSTI; NTIS; INIS; GPO Dep.

This report presents summaries for two months of current research of the Idaho National Engineering Laboratory (INEL) Boron Neutron Capture Therapy (BNCT) Program. Information is presented on development and murine screening experiments of low-density lipoprotein, carboranyl alanine, and liposome boron containing compounds. Pituitary tumor cell culture studies are described. Drug stability, pharmacology and toxicity evaluation of borocaptate sodium (BSH) and boronophenylaianine (IBPA) are described. Treatment protocol development via the large animal (canine) model studies and physiological response evaluation in rats are discussed. Supporting technology development and technical support activities for boron drug biochemistry and purity, analytical and measurement dosimetry, and noninvasive boron quantification activities are included for the current time period. Current publications for the two months are listed.

6644 (INIS-BR–3092) **Convergence analysis of a relaxed EM algorithm with uses in emission tomography.** Iusem, A.N. Instituto de Matematica Pura e Aplicada (IMPA), Rio de Janeiro, RJ (Brazil). 1989[4] (In Portuguese). (CONF-8909464–: 12. Brazilian congress of applied computational mathematics, Sao Jose do Rio Preto (Brazil), 4-8 Sep 1989). Order Number DE93609305. Source: OSTI; NTIS (US Sales Only); INIS.

This work describes the Position Emission tomography technique this technique consists of introducing in the organism a radioactive substance and determining its concentration in each part of the body by measuring its emission in a detectors ring. (A.C.A.S.).

6645 (INIS-mf–13399) **Workshop of medical physics.** Centro Latino Americano de Fisica (CLAF), Rio de Janeiro, RJ (Brazil); Comision Nacional de Energia Atomica, Buenos Aires (Argentina); Universidad Nacional de Cuyo, Mendoza (Argentina). 1988[305] (In English, Spanish). (CONF-8811381–: Workshop on medical physics, San Carlos de Bariloche (Argentina), 14-18 Nov 1988). Order Number DE93609262. Source: OSTI; NTIS (US Sales Only); INIS.

This event was held in San Carlos de Bariloche, Argentine Republic from 14 th. through 18 th. November, 1988. A great part of the physicians in the area of medical physics participated in this workshop. This volume includes the papers presented at this Workshop of Medical Physics.

6646 (INIS-mf–14095) **Radiological cadastre of the Land Hessen. Report on the handling of unsealed radioactive material in Hessen from 1980 until 1989. Working field: Medical science.** Umweltplanung, Arbeits- und Umweltschutz. Schriftenreihe der Hessischen Landesanstalt fuer Umwelt. Musigk, H. Hessische Landesanstalt fuer Umwelt, Wiesbaden (Germany). Aug 1991 62p. (In German). Order Number DE93742640. Source: OSTI; NTIS (US Sales Only); INIS.

The radiological survey covering the years 1980 until 1989 shows a slight increase both in the number of appliers of unsealed radioacive material in the medical field and in the overall radioactivity applied. The steadily rising number of medical examinations observed in the years 1980 until 1983 turned to a downward trend since then. The number of therapentical treatments unsing unsealed radioactive sowes reported for the year 1989 is almost consistent with the number of the previous years. (orig.).

6647 (INIS-SU–324/A) **Nuclear magnetic resonance in diagnostics of internal diseases.** Malaya, L.T.; Uvarov, N.I.;

Shashura, Yu.V.; Miklyaev, I.Yu.; Zhmuro, A.V. AN Ukrainskoj SSR, Kharkov (Ukraine). Inst. Radiofiziki i Ehlektroniki. 1990. [56] (In Russian). Order Number DE93609263. Source: OSTI; NTIS (US Sales Only); INIS.

Use of NMR-tomography in general and differential diagnosis of brain diseases, diseases of internal organs (liver, galbludder, pancreas, kidneys, adrenal glands, organs small pelvis, thoracic cavity, soft tissues and bone-jopint system) is shown. Physical-technical bases of getting NMR image are presented. Problems of reproducibility, accuracy and interpretation of investigation results are discussed. 253 refs.; 1 tab.

6648 (LUMEDW-MEMA–1038-1-100-1992) **Diagnostic and therapeutic aspects of deep vein thrombosis.** Lagerstedt, C. Lund Univ. (Sweden). Dept. of Internal Medicine. 1992. [50] Order Number DE93609306. Source: OSTI; NTIS; INIS.

51 out-patients presenting with calf-vein thrombosis were randomized to treatment with heparin for five days or heparin with subsequent warfarin for three months. Among 23 patients in the warfarin-group no recurrence occurred, whereas 8 of the 28 patients (29%) in the non-warfarin group had recurrent thromboembolism during the first 90 days. It is concluded that patients with symptomatic calf-vein thrombi should be treated with both heparin and oral anticoagulation. In a prospective study of X-ray contrast media, post-phlebographic reactions occurred in 7 of 19 patients (37%) investigated with a high-osmolality contrast medium metrizoate whereas no such reaction occurred among 24 patients investigated with a low-osmolality contrast medium iohexol. Thus, low-osmolatily contrast media should preferably be used at phlebography. 396 out-patients with suspected venous thrombosis were investigated with the ^{99m}Tc-plasmin test, physical examination and phlebography. The plasmin test has a high sensitivity (95%) but a low specificity (47%), and was frequently abnormal when clinical signs of inflammation were present. Clinical signs could not accurately predict if thrombosis was present, although subpopulations of patients with high or low probability of venous thrombosis could be identified. 112 patients with suspected DVT were investigated with thermography. Both sensitivity and specificity were low (77% and 66% respectively) and thermography therefore seems not to be useful in the diagnosis of symptomatic venous thrombosis. Long-term sequelae after a first episode of venous thrombosis are mostly mild as long as 6 years after the diagnosis. Venous function correlated to the extension of the thrombus but no to subjective symptoms. Clinical signs at diagnosis could not predict the late outcome. During the six years of follow-up, 28% of the patients had recurrent thrombosis. (158 refs.) (au).

6649 (LUMEDW-MEOK–1015/1992) **Hyperthermia and radiotherapy: A study on malignant superficial tumours.** Lindholm, C.E. Lund Univ., Malmoe (Sweden). Dept. of Oncology. 4 Apr 1992. [107] Order Number DE93609315. Source: OSTI; NTIS; INIS.

Combined hyperthermia (HT 45 min once or twice per week) and low dose radiotherapy (LDRT 30-34.5 Gy in 2-3 weeks) have been given to 182 locally recurrent or metastatic superficial tumours in 133 patients. Tumour response was analysed in 137 tumours in 100 patients. The overall complete response (CR) was 50% with a median duration (DCR) of 13±3 months. When mammary carcinoma, representing 62% of the treated tumours, were analysed, CR was 62% with a DCR of 14±4 months. In a comparative, non-randomized study, on 34 matched tumour pairs in 24 patients, treatment was given with LDRT+HT to the larger and the same LDRT to the smaller tumour, the patients acting as their own control. A significant difference in CR was obtained in favour of the combined treatment (p=0.0013 all diagnosis and p=0.0027 mammary carcinoma). There was no significant difference in DCR between the two modalities. No significant difference in CR was seen when tumours were randomely treated with HT once (CR 56%) or twice (CR 69%) per week combined with the same LDRT. Predictive factors for CR, multivariately analysed (15 parameters), in mammary carcinoma recurring in earlier irradiated regions, were; the present LDRT absorbed dose (p=0.02) and the average minimum temperature in the best HT session (p=0.03). Significant skin toxicity was seen in 28% of all the 182 heated regions. Prognostic factors for skin damage, multivariately analysed, were; the extension of the heated region (p=0.007) and the highest average maximum temperature in any of the HT sessions (p=0.04). Pain was in some way correlated to severe toxicity but was not considered to be an optimal monitor for HT as many patients with severe and moderate pain were without any serious skin reactions, while slight or no pain sometimes were associated with severe reactions. 401 refs.

6650 (SAND–92-2410C) **Micro-radiosurgery: A new concept for radiotherapy based upon low energy, ion-induced nuclear reactions.** Horn, K.M.; Doyle, B.L. Sandia National Labs., Albuquerque, NM (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-921116–15: 12. international conference on the application of accelerators in research and industry, Denton, TX (United States), 2-5 Nov 1992). Order Number DE93003995. Source: OSTI; NTIS; GPO Dep.

Traditionally, proton radiotherapy has required the use of high energy proton beams (50–200 MeV) which can penetrate into a patients body to the site of a tumor that is to be destroyed through irradiation. However, substantial damage is still done to healthy tissue along the path of the incident proton beam, as 40% of that done at the tumor site. We propose a new concept for the production and delivery of energetic protons for use in medical radiotherapy, based upon the fact that low energy, ion-induced nuclear reactions can produce radiation products suitable for use in radiotherapy applications. By employing specially fabricated "conduit needles" to deliver beams of energetic ions to selected target materials plugging the end of the needle, ion beam-induced nuclear reactions can be generated at the needle tip, emitting reaction-specific radiation products directly at the tumor site In this paper, we show that the 13.6 MeV protons produced by the d(^{3}He,p)^{4}He nuclear reaction can deliver a lethal dose (7 krad) of radiation to a 4.4 millimeter sphere of tissue in only 30 seconds using a 1 microamp, 800 keV ^{3}He ion beam. If also proven clinically feasible, the use of low energy, ion-induced nuclear reactions would allow the utilization of relatively inexpensive, compact, low-energy ion accelerators for proton radiotherapy and minimize unintended radiation damage to healthy tissue by providing much greater precision in controlling the irradiated volume.

6651 (SAND–92-8524) **Quantum chemical studies of phosphoramide mustard and isophosphoramide mustard.** Colvin, M.E. (Sandia National Labs., Livermore, CA (United States)); Melius, C.F.; Ludeman, S.M.; Colvin, O.M.; Gamcsik, M.P.; Hausheer, F.H. Sandia National Labs., Livermore, CA (United States). May 1992. 26p. Sponsored by USDOE, Washington, DC (United States); Department of Health and Human Services, Washington, DC (United States). DOE Contract AC04-76DR00789. Grant CA16783;Grant CA51229. Order Number DE93002671. Source: OSTI; NTIS; GPO Dep.

Phosphoramide mustard (PM) and isophosphoramide mustard (IPM) are the active metabolites of two important alkylating anticancer drugs cyclophosphamide and ifosfamid. Although PM and IPM are structurally similar they have very different reactivities. In order to elucidate the origin of these differences, we have performed ab initio quantum chemical calculations on all plausible protonation states of PM and IPM. These calculations involved 6-31g* self-consistent field structure optimizations followed by single point 6-31g** second-order Moller Plesset energy calculations. Additionally a polarizable continuum model was used to estimate the aqueous-phase energetics. Both PM and IPM are predicted by this study to have a zwitterionic aqueous-phase ground state. It is possible that protonation of the reactive sites may underlie the observed differences in reaction rate. The effects of protonation on the structure and electronic distribution of the phosphoramide moeity are also discussed.

5507 Microbiology

Refer also to citation(s) 4873, 4886, 5199, 5230, 6638

5508 Morphology

Refer also to citation(s) 6710

5509 Pathology

Refer also to citation(s) 6668, 6778

5510 Physiological Systems

Refer also to citation(s) 6784, 6785, 7141

6652 (LA-UR–92-3410) **Computational mechanics at Los Alamos National Laboratory.** Anderson, C.A. Los Alamos National Lab., NM (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-921110–34: Winter annual meeting of the American Society of Mechanical Engineers (ASME), Anaheim, CA (United States), 8-13 Nov 1992). Order Number DE93003725. Source: OSTI; NTIS; GPO Dep.

Supercomputers can be used to solve structural problems characterized by complex material behavior and geometry. This paper presents two examples of supercomputer applications in structural mechanics that are industry driven-numerical analysis of the process of radial keratotomy of the human eye and an analysis of the fracture of a pump block.

5530 Agriculture and Food Technology

Refer also to citation(s) 5266, 5817, 5818, 5829, 5830, 5831, 5986, 5987, 5988, 6072, 6073, 6154, 6591

6653 (AI-DOE–13557-Vol.1) **CACI: Cesium-137 Agricultural Commodities Irradiator: Final design report: Volume 1, Project summary.** Subbaraman, G.; Conners, C.C. Rockwell International Corp., Canoga Park, CA (United States). Rocketdyne Div. 19 Dec 1986. 167p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-85AL25763. Order Number DE93000751. Source: OSTI; NTIS; GPO Dep.

This report provides a complete description of the final detailed design of the Cesium-137 Agricultural Commodities Irradiator (CACI). The design was developed and successfully completed by the Rocketdyne Division of Rockwell International for the US Department of Energy (DOE). The CACI project was initiated in April 1985 under DOE's Byproducts Utilization Program, with the objectives of transferring food irradiation technology to the industry and thereby demonstrating a beneficial use for the 137 Cs nuclear by-product isotope. As designed, CACI will meet the intended requirements for research, development, and demonstration of irradiation processing of food. Further, as shown in the safety analyses performed during the project, the design conforms to all the safety and licensing requirements set forth for the project. The original scope of the CACI project included completion of its construction. However, the project was terminated for the convenience of the government during the final design phase in February 1986 for lack of a specific site.

6654 (ETDE-mf–93750693) **Comparative gas exchange measurements on spruce under clean air respectively site air for qualitative establishment of primary damage due to air pollutants. Final report.** Koch, W. Forschungszentrum Juelich GmbH (Germany). Projekttraeger Biologie, Energie, Oekologie; Muenchen Univ. (Germany). Lehrstuhl fuer Forstbotanik; Bundesministerium fuer Forschung und Technologie, Bonn (Germany). [1992] 77p. (In German). Contract BMFT 0339180B. Order Number DE93750693. Source: OSTI; NTIS (US Sales Only).

How harmful are gaseous air pollutants to the primary capability of spruces for producing plant tissue under natural site conditions? To elucidate this question, a pair of twigs in the summit area of a 70-year-old tree exhibiting the symptoms of 'novel forest disease' were fumigated for four years without interruption with clean air and site air using completely air-conditioned gas exchange chambers. CO_2 and vapour exchange including all climate data and air pollutant concentrations (SO_2, NO, NO_2 and O_3 as well as spot samples of airborne organic compounds) were recorded without interruption at intervals of four minutes. From the middle of the third year of the experiment, SO_2 and O_3 could be subsequently dosed according to the external air concentrations in order to make up for unavoidable losses in the measuring system. In addition it was possible by the end of the third year of the experiment to simultaneously expose the twigs inside the chambers to overhead irrigation with clean rainwater respectively rainwater from the site during precipitation events. (orig.).

6655 (IAEA-R–5901-F) **Use of isotopes for increasing biological nitrogen fixation and yield of pastures: Final report for the period 1 March 1991 - 28 February 1992.** Yao Yunyin (Chinese Academy of Agricultural Sciences, Beijing (China). Inst. for Application of Atomic Energy). International Atomic Energy Agency, Vienna (Austria). May 1992. [50] Order Number DE93609185. Source: OSTI; NTIS (US Sales Only); INIS.

The N-15 natural abundance and N-15 isotope dilution (ID) methods for measuring dinitrogen fixation and nitrogen transfer in alfalfa and alfalfa intercropped with meadow fescue were compared in three experiments. Although both methods gave essentially the same estimates the precision of the values obtained differed, and values obtained by the isotope dilution method were more precise. Similarly, the N-15 natural abundance method was not very suitable for detecting N transfer from legume to non-legume. Greater amounts of N transfer were detected by the ID method, and with a greater precision. Mixed cropping sometimes gave slight to high increases in % nitrogen fixation compared to alfalfa cropped alone. On the whole alfalfa was found to be a high nitrogen fixer, with fixation values from the second harvest onwards almost always greater than 80% and often close to 100%. 23 refs, 30 tabs.

6656 (INIS-BR–3089) **Information about the CENA: Agriculture Nuclear Energy Center.** Centro de Energia Nuclear na Agricultura (CENA), Piracicaba, SP (Brazil). Oct 1982[68] (In Portuguese). Order Number DE93609186. Source: OSTI; NTIS (US Sales Only); INIS.

The purposes of the CENA-Brazil is described in this paper such as to develop and absorb techniques and nuclear methods of research interest and agricultural applications; to spread the methods and techniques through the courses, scientific exchange and publications; to develop in permanent character, researches, studies and works of nuclear energy application in agricultural problems and transfer the technology to the public; cooperation programs with the others units and USP-Sao Paulo University in graduation and post-graduation courses. (L.M.J.).

6657 (INIS-mf–13389) **Mutation Breeding Newsletter. No. 39.** Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Jan 1992[47] Order Number DE93609187. Source: OSTI; NTIS (US Sales Only); INIS.

Hard copies are available from Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture.

This newsletter contains brief articles on the use of radiation to induce mutations in plants; radiation-induced mutants in Chrysanthemum; disrupting the association between oil and protein content in soybean seeds; mutation studies on bougainvillea; a new pepper cultivar; and the use of mutation induction to improve the quality of yam beans. A short review of the seminar on the use of mutation and related biotechnology for crop improvement in the Middle East and Mediterranean regions, and a description of a Co-ordinated Research Programme on the application of DNA-based marker mutations for the improvement of cereals and other sexually reproduced crop species are also included. Two tables are given: these are based on the "FAO/IAEA Mutant Varieties Database" and show the number of mutated varieties and the number of officially released mutant varieties in particular crops/species. Refs and tabs.

6658 (INIS-mf–13394) **Use of irradiation to assure the hygienic quality of animal origin foods.** Luna Carbajal, P. C. Universidad Nacional Autonoma de Mexico, Mexico City (Mexico). Facultad de Quimica. 1991[171] (In Spanish). Order Number DE93609196. Source: OSTI; NTIS (US Sales Only); INIS.

Irradiation process for food preservation is a physical method comparable to heat or refrigeration and consist on the exposure of

products packed or in bulk to gamma rays comming from Cobalt-60 or Cesium-137 or accelerated electrons and X rays produced by electric machines known as accelerators. Foods are exposed to this form of energy during a pre-stablished period in facilities named irradiators. At industrial level, the irradiation process requires a well stablished control to reach a good quality in the product. This quality control is carry out by means of dosimetry, a system which assures that the energy amount received by food is correct. Benefits derived of irradiation process in meat products as chicken, beef and pork as well as implications in matter of health and economics are presented in this work. Different aspects of irradiation process as a control to assure the hygienic quality, costs, different option of irradiators at industrial level, its advantages upon other processes, and its benefits at social level, are presented in this work. With respect to wholesomeness of irradiated food, main studies to strenghten that an irradiated food is safe, non toxic, do not imply microbian risks. it has the better nutritional quality, it has no radioactive remains and it is not a radioactivity inductor, in a word is an inocuous food, are presented in this study (Author).

6659 (TVA/NFDC–90/2) **Commercial fertilizers: Total US fertilizer consumption 44.9 million tons in 1989.** Hargett, N.L.; Berry, J.T.; McKinney, S.L. National Fertilizer Development Center, Muscle Shoals, AL (United States). 1989. 31p. Sponsored by Tennessee Valley Authority, Knoxville, TN (United States). (TVA-Bull–Y-211). Order Number DE93003904. Source: OSTI; NTIS.

US fertilizer consumption for the 1988–1989 year was 44.9 million tons of material-an increase of less than one percent from the previous year. The average plant nutrient content of all fertilizers decreased slightly as total plant nutrient consumption declined from 19.61 million to 19.59 million tons of N, P_2O_5, and K_2O. Total nitrogen consumption increased one percent to 10.63 million tons, while P_2O_5 use decreased by less than one percent to 4.12 million tons. Potash consumption declined from 4.97 million tons to 4.83 million tons K_2O-a 2.8 percent decrease. Consumption patterns varied widely from state to state as weather conditions adversely affected fertilizer application even with significant increases in total planted crop acreage. Illinois, Indiana, Iowa, Minnesota, and Ohio reported a decline in total plant nutrient application while several of the southeastern states registered an increase in consumption. Nutrient levels in mixed fertilizers remained unchanged as slight gains in the nitrogen and P_2O_5 content were offset by a decline in K_2O. Consumption of ammonium polyphosphate solution (10-34-0) and monoammonium phosphates increased 9.2 percent and 12.8 percent respectively, while diammonium phosphate (18-46-0) use was 2.4 percent below last year. A general increase in the use of nitrogen materials was reported with the exception of nitrogen solutions which declined 2.1 percent from 1987–1988. Urea consumption rose almost 2 percent. ammonium nitrate was up 8.1 percent, and ammonium sulfate recorded a 9.5 percent gain in consumption. Anhydrous ammonia use was only 35,000 tons above last year. This document contains a state by state listing of individual fertilizer consumption rates, numerical data only.

6660 (TVA/NFDC–90/4) **Fertilizer use by class: Bag, bulk, fluid: US fertilizer consumption by class.** Hargett, N.L.; Berry, J.T.; McKinney, S.L. National Fertilizer Development Center, Muscle Shoals, AL (United States). 1989. 12p. Sponsored by Tennessee Valley Authority, Knoxville, TN (United States). (TVA-Bull–Y-212). Order Number DE93003905. Source: OSTI; NTIS.

US fertilizer consumption (excluding natural organic, secondary, and micronutrient materials) increased slightly from 42.7 million tons in 1987–1988 to 42.8 million tons in 1988–1989-a gain of less than one percent. In 1988–1989, dry bulk materials represented 52.1 percent of total consumption, fluid fertilizers accounted for 38.9 percent, and bagged materials the remaining 9.0 percent. Both dry and fluid fertilizers increased in tonnage over last year but market shares of each remained essentially the same. Bagged fertilizer continued to drop in tonnage as well as in market share. Fluid fertilizer use (including anhydrous ammonia) exceeded 16.6 million tons. Solid materials accounted for 26.2 million tons. TVA estimates that total dry bulk fertilizer distribution was 22.3 million tons, representing 85 percent of all solid materials. Estimated fertilizer sales of bagged products was 3.9 million tons compared to 4.1 million tons in 1987–1988. Multiple-nutrient fertilizer consumption was 17.5 million tons in 1988–1989. Class distribution of these materials was 60.1 percent dry bulk form, 22.4 percent fluid, and 17.5 percent bagged. Fluid multiple-nutrient materials consumption remained about the same as for 1987–1988 but increased in total market share from 9.1 percent to 9.2 percent. This report is compiled annually from individual State fertilizer tonnage reports. Forty States provided complete breakdown by class in 1988-1989. Only numerical data is included.

6661 (TVA/NFERC–90/9) **Commercial fertilizers 1990.** Hargett, N.L.; Berry, J.T. National Fertilizer and Environmental Research Center, Muscle Shoals, AL (United States). Dec 1990. 31p. Sponsored by Tennessee Valley Authority, Knoxville, TN (United States). (TVA-Bull–Y-216). Order Number DE93003915. Source: OSTI; NTIS.

US plant nutrient consumption increased 5.5% in 1989–1990 reaching 20.62 million tons. The total for all fertilizer materials was 47.71 million tons, the highest level of distribution since 1984–1985. Nitrogen consumption was 11.08 million tons compared to 10.59 million tons last year–a gain of 4.6 percent. Urea and nitrogen solution use increased by more than 10 percent while the direct application of ammonia remained the same as last year. Phosphate use rose 5.5 percent to 4.34 million tons of P_2O_5. Significant increases were recorded for all phosphate materials except concentrated superphosphate. Potash consumption recovered sharply from last year registering a 7.5 percent increase in use to 5.20 million tons of K_2O. With few exceptions, the gain in fertilizer use in 1989-90 encompassed the entire country. Only 11 states indicated minor declines in consumption while 20 states increased use by more than 10 percent. The six states that comprise the midwest cornbelt and account for 30 percent of total US fertilizer consumption, increased use by 10.5 percent to over 14.4 million tons of material.

6662 (TVA/NFERC–91/7) **Chemical behavior of indigenous impurities (Al, Fe, Si, Mg, F, K, Na, NH_3, Ca, and SO_4) during the production of filter-grade wet-process phosphoric acid.** Sullivan, J.M.; Frazier, A.W.; Griffin, C.L.; Grinstead, J.H. Jr.; Kim, Y.K.; Kohler, J.J. National Fertilizer and Environmental Research Center, Muscle Shoals, AL (United States). [1992]. 66p. Sponsored by Tennessee Valley Authority, Knoxville, TN (United States). (TVA-Bull–Y-220). Order Number DE93003873. Source: OSTI; NTIS.

The conventional (dihydrate process) extraction of phosphate rocks with sulfuric acid and subsequent filtration results in a dilute "filter-grade" wet-process phosphoric acid (WPA) containing many cationic and anionic impurities which can cause problems during fertilizer production. Most of these problems result because many of the impurities are present in amounts above saturation. This factorial study was designed to define the nature and amounts of components precipitating from simulated filter-grade (28% P_2O_5) phosphoric acid at 85, 68, and 25 C, with 2-day retention times. Results show that the precipitation of the iron ammonium and iron potassium phosphates generally provide the largest source of solids in filter-grade phosphoric acid; Mg and Ca fluoroaluminates and alkali fluorosilicates also provide a significant proportion of solids. The distribution of solids between these 3 groups is governed by the F/Si ratio in the acid. The study also delineates the deleterious effect of ammonia contamination (such as from ammonia leakage to gypsum ponds).

6663 (TVA/NFERC–91/8) **Controlled release fertilizer workshop, 1991: Proceedings.** Scheib, R.M. (ed.). National Fertilizer and Environmental Research Center, Muscle Shoals, AL (United States). Nov 1991. 104p. Sponsored by Tennessee Valley Authority, Knoxville, TN (United States). (TVA-Bull–Y-221;CONF-9107245–; Controlled release fertilizer workshop - 1991, Sheffield, AL (United States), 30-31 Jul 1991). Order Number DE93003872. Source: OSTI; NTIS.

Over the last 20 years the Tennessee Valley Authority's National Fertilizer and Environmental Research Center (NFERC) has carried out a number of programs to develop controlled release fertilizers. They pioneered the development and commercialization of sulfur coated urea and conducted extensive research in an attempt to develop an economical synthesis for oxamide. In recent years there has developed an increasing interest in the environmental impact

of fertilizers, particularly on the potential for ground water contamination by nitrate derived from fertilizer materials. In response to this interest NFERC's Chemical Research Department organized a five member Controlled Release Fertilizer (CRF) Team to reassess the potential for controlled release materials in agriculture with a view to minimizing any adverse environmental impact and increasing the efficiency of nutrient utilization by the crop. This workshop was part of that reassessment program. The workshop goals were: To determine the present status of CRF research, production and use; to assess the future needs of CRF producers and consumers; and to promote communication and exchange of information. To accomplish these goals the team invited speakers from across' the United States representing academics, experimental station researchers, fertilizer producers, environmentalists, and marketing experts to present papers.

6664 (TVA/NFERC–91/15) **Commercial fertilizers 1991.** Hargett, N.L.; Berry, J.T.; Montgomery, M.H. National Fertilizer and Environmental Research Center, Muscle Shoals, AL (United States). Dec 1991. 40p. Sponsored by Tennessee Valley Authority, Knoxville, TN (United States). (TVA-Bull–Y-225). Order Number DE93003921. Source: OSTI; NTIS.

This document contains consumption data for commercial fertilizers in the USA for 1991. Graphical information on the consumption by class is given for the nation. State by state data for consumption of several types of commercial fertilizers are presented. Only numerical data is included.

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

Refer also to citation(s) 5043, 5229, 5487, 5612, 6632, 7459

6665 (CONF-8909210–, pp. 633-649) **The irradiation of glycylglycine in aqueous solution - A case study of calculations from track structure to biochemical change.** Turner, J.E. (Oak Ridge National Lab., TN (United States)); Yoshida, H.; Jacobson, K.B.; Crawford, O.H.; Hamm, R.N.; Bolch, W.E.; Wright, H.A. Oak Ridge National Lab., TN (United States). Apr 1990. DOE Contract AC05-84OR21400. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

The authors have carried out detailed Monte Carlo calculations of electron tracks produced by X rays in liquid water. The calculations start with the initial physical interactions and proceed in time with radical formation and subsequent chemical changes. They have treated the explicit chemical changes that occur when the dipeptide glycylglycine is present and have calculated the yields of various chemical products. They have also measured the chemical yields under the same experimental conditions as were assumed in the computations. Excellent agreement is obtained between the results of the measurements and the calculations. This work was carried out as a step toward the study of the more complicated DNA. These studies represent the first detailed linking of the basic physics of radiation interaction with the later observed biochemical effects.

6666 (CONF-8909210–, pp. 673-680) **Calculations of Auger-cascade-induced reactions with DNA in aqueous solution.** Hamm, R.N. (Oak Ridge National Lab., TN (United States)); Wright, H.A.; Turner, J.E.; Howell, R.W.; Rao, D.V.; Sastry, K.S.R. Oak Ridge National Lab., TN (United States). Apr 1990. DOE Contract AC05-84OR21400. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

The biological effects of radionuclides incorporated into mammalian cells are of considerable interest for radiation biology and radiation protection. When radionuclides decay by electron capture or internal conversion an inner-atomic-shell vacancy is created. The subsequent Auger transitions produce numerous low-energy electrons whose ranges are of subcellular dimensions in tissue-equivalent matter. When such Auger emitters are localized on or near the DNA of cell nuclei, severe biological effects are observed, both in vitro and in vivo, reminiscent of alpha particles of high linear energy transfer (LET). Indeed, recent experiments with the 5.3-MeV alpha emitter Po-210, intracellularly localized, clearly showed that its lethal effects were essentially the same as those of DNA-incorporated I-125, a prolific Auger emitter. The relatively high radiotoxicity of Auger emitters has been attributed to the highly localized energy density in the immediate vicinity of their decay sites. A more detailed understanding of the equivalent lethality of high-LET alpha particles and DNA-bound Auger emitters may come from track-structure calculations which provide information on the number of direct physical interactions and subsequent indirect chemical interactions with the DNA molecule. Accordingly, track-structure calculations for a variety of medical and environmental radionuclides (Fe-55, In-111, I-125, Pt-193m, Pt-195m) which emit different numbers of Auger electrons are considered in this work and compared with those for alpha particle tracks.

6667 (DOE/EH–0278T-App.) **Occupational dose reduction at Department of Energy contractor facilities: Study of ALARA programs: Good practice documents: Appendices.** Dionne, B.J. (Brookhaven National Lab., Upton, NY (United States)); Meinhold, C.B.; Khan, T.A.; Baum, J.W. USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (United States). Office of Health; Brookhaven National Lab., Upton, NY (United States). Aug 1992. 116p. Sponsored by USDOE, Washington, DC (United States). (BNL–47339-App.). Order Number DE93004889. Source: OSTI; NTIS; GPO Dep.

These appendices are a supplement to the report entitled "Occupational Dose Reduction at Department of Energy Contractor Facilities: Study of ALARA Programs–Status 1990. " The report describes the results of a survey conducted at various Department of Energy (DOE) contractor facilities during 1989 and 1990 to assess the current status of ALARA program implementation. This supplement to that report contains examples of generic "good practice" documents typically associated with implementing the major elements of a formally documented ALARA program at a major DOE contractor facility. These good practice ALARA program documents were developed based on the best representative examples from the visited contractor facilities, supplemented as necessary with examples from the commercial nuclear industry. Other techniques, methods or practices may be as good or better (the authors would appreciate hearing or receiving information about them). These good practice documents are provided as an optional resource for incorporation into existing contractor ALARA programs. It should be noted that these documents were developed prior to the issuance of the Department of Energy Radiological Control (RadCon) Manual, and consequently do not reflect in all instance's the requirements or specific terminology of that manual. These good practice documents were also designed to be consistent with current DOE Order requirements, where applicable; however, subsequent revisions to DOE Orders may make these documents outdated. The user should consequently review and update these good practice documents against the requirements of the RadCon Manual and against any revisions to applicable DOE Orders prior to their implementation.

6668 (DOE/ER/60524–6) **Malignant transformation of diploid human fibroblasts by transfection of oncogenes: Part 2, Progress report, July 1989–June 1992.** McCormick, J.J. Michigan State Univ., East Lansing, MI (United States). Carcinogenesis Lab. [1992]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-87ER60524. Order Number DE93005873. Source: OSTI; NTIS; INIS; GPO Dep.

This document consist of brief reports prepared by postdoctoral students supported by the project, each describing his accomplishments under the grant. Topics include (1) Malignant Transformation of MSU-1. 1 Cells by Gamma Radiation, (2) Correlation between Levels of ras Expression and Presence of Transformed Phenotypes Including Tumorigenicity, Using a Modulatable Promoter, (3)

Relation between Specific rad Oncogene Expression, (4) Correlation of Genetic Changes in Fibroblastic Tumors with Malignancies, (5)Transformation of MSU-1.1 Cells by sis Oncogene, (6) Malignant Transformation of MSU-1.0 Cells, (7) Correlation of Urokinase Plasminogen Activation (mu-PA) with Malignant Phenotype, (8)Two Dimensional Gel Electrophoresis Studies of the Proteins of the Major Cell Strains of the MSU-1 Family of Cells, and (9) Correlation between Proteinase Activity Levels and Malignancy.

6669 (DOE/ER/60592–9) **Deposition of inhaled charged ultrafine particles in a simple tracheal model.** Cohen, B.S.; Ayres, L.; Xiong, J. New York Univ., NY (United States). Medical Center. [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-87ER60592. (CONF-9210221–1: American Association for Aerosol Research annual meeting, San Francisco, CA (United States), 12-16 Oct 1992). Order Number DE93003162. Source: OSTI; NTIS; GPO Dep.

The deposition of ultrafine ($d \leq 200$ nm) particles on airway surfaces is an important determinant of the radiation dose that results from inhalation of radon progeny. The activity median diameter of particles to which radon daughters attach is small (10–140 nm). In the absence of charge, deposition in the upper airways of the respiratory system occurs by impaction for large particles and diffusion for small particles. Sedimentation is negligible due to the high flow rates in these airways. Experiments conducted in hollow casts and in vivo in humans have all shown an increase in deposition due to the particle charge. In vivo experimental results showed that there exists a threshold value of charge on the particle (q_c) above which the electrostatic charge enhances deposition. These experiments were performed for particles for which deposition by diffusion is small ($d \leq 300$ nm). Deposition of ultrafine particles in the airways may occur by a combined mechanism of diffusion and electrostatic charge.

6670 (DOE/ER/60678–5) **Factors affecting mutational specificity induced by ionizing radiation and oxidizing radicals: Technical progress report, February 1, 1992–October 15, 1992.** Strauss, B.S. Chicago Univ., IL (United States). Jan 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER60678. Order Number DE93006077. Source: OSTI; NTIS; INIS; GPO Dep.

We propose to analyze the factors affecting the specificity of mutational change as induced by ionizing radiation and oxidizing radicals. We want to understand not only the rules that affect base substitution, but also the mechanism(s) by which additions and deletions are produced, since detections are a common consequence of radiation. We wish to carry out this analysis in an in vitro mutation system that permits us to analyze the role of base sequence, of polymerase and of mutagenic agent. Our system is designed to screen out most direct breaks as a cause of mutation and should indicate the changes resulting from base damage to the DNA.

6671 (DOE/ID–12082(91)) **The Idaho National Engineering Laboratory Site environmental report for calendar year 1991.** Hoff, D.L.; Mitchell, R.G.; Moore, R.; Bingham, L. USDOE Idaho Field Office, Idaho Falls, ID (United States). Sep 1992. 125p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE93003642. Source: OSTI; NTIS; INIS; GPO Dep.

The results of the various monitoring programs for 1991 indicate that most radioactivity from the Idaho National Engineering Laboratory (INEL) operations could not be distinguished from worldwide fallout and natural radioactivity in the region surrounding the INEL Site. Although some radioactive materials were discharged during Site operations, concentrations and doses to the surrounding population were of no health consequence and were far less than State of Idaho and Federal health protection guidelines. The first section of the report summarizes Calendar Year 1991 and January 1 through June 1, 1992, INEL activities related to compliance with environmental regulations and laws. The major portion of the report summarizes results of the RESL environmental surveillance program, which includes the collection of foodstuffs at the INEL boundary and distant offsite locations, and the collection of air and water samples at onsite locations and offsite boundary and distant locations. The report also compares and evaluates the sample results to appropriate federal regulations and standards and discusses implications, if any. The US Geological Survey (USGS) groundwater monitoring program is briefly summarized and data from USGS reports are included in tables and maps showing the spread of contaminants. Effluent monitoring and nonradiological drinking water monitoring performed by INEL contractors are discussed briefly and data are summarized in tables.

6672 (DPW–53-129) **Substitution of 20% HNO_3 for 50% HNO_3 in vessel decontamination.** Webster, D.S. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 7 Jan 1953. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-76SR00001. (SR/H–268). Order Number DE93004348. Source: OSTI; NTIS (US Sales Only); GPO Dep.

50% HNO_3 is no better than 20% HNO_3, and is inferior to 20% HNO_3 - 3% HF, for decontaminating stainless steel vessels.

6673 (ECN-C–91-075) **Neutron metrology in the HFR: Neutron and gamma metrology in two beagles and one cylindrical phantom.** Voorbraak, W.P.; Freudenreich, W.E.; Stecher-Rasmussen, F.; Verhagen, H.W. Netherlands Energy Research Foundation (ECN), Petten (Netherlands). Oct 1991. [44] Project ECN 1244.01. Order Number DE93609530. Source: OSTI; NTIS; INIS.

This work was performed under contract of the European Collaboration on Boron Neutron Capture Therapy.

Neutron fluence rate and gamma dose data are presented for the first series of experiments at the filtered HFR beam HB11 at full reactor power. Measurements were performed on two beagle dogs and one cylindrical phantom. The main results for thermal and epithermal fluence rates, physical neutron dose and gamma dose are presented in the tables 1 and 2. (author). 10 refs.; 9 figs.; 8 tabs.

6674 (FS–92-62-AKURA) **Radiation exposure and radiation induced occupational diseases in uranium mining using Wismut as an example. Statement of the Working Group on Uranium Mining and Radioactive Residues of Mining.** Fachverband fuer Strahlenschutz e.V., Karlsruhe (Germany). Apr 1992. 17p. (In German). Order Number DE93742868. Source: OSTI; NTIS (US Sales Only); INIS.

Since the 16th century a deadly lung disease was oberved hitting miners in the Saxonian area of Schneeberg. The disease was identified as bronchiogenic cancer 120 years ago. This miners disease can be observed worldwide, if the rocks of mines contain a considerable amount of uranium or thorium or if the seepages carry radon gases. Thirty to forty years ago the radioactive decay products of the noble gas isotope radon-222 were recognized as a substantial cause in the case of uranium mining. At Wismut which started uranium mining in 1946 the annual individual radiation exposure below ground is assumed to average 150 WLM (1500 mSv) until 1955 and thereafter it was reduced successively and drastically to an average of 2 WLM (20 mSv) and less per annum since 1976. As one result of international epidemiological studies ICRP and IAEA recommended at last an annual exposure limit of 4,8 WLM (48 mSv) and 5 WLM (50 mSv) respectively after 1980. Until 1990 the Social Insurance Wismut recognized 5237 cases of bronchiogenic cancer as occupational diseases. Additionally to a backlog - in the future about 200 recognitions are expected to arise annually. About 98% of all previously recognized cases affect miners who started their mining activities before 1955. (orig.).

6675 (FTINT–16-89) **Immunological aspects of the investigation in the effect of external UV-irradiation and UV-irradiated biolipids of the Langerhans cell.** Volyanskij, Yu.L.; Marchuk, L.M.; Telepneva, L.G. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. Nizkikh Temperatur. 1989. [41] (In Russian). Order Number DE93609133. Source: OSTI; NTIS (US Sales Only); INIS.

The origin and role of the Langerhans cell are considered in the immune response of the organism, as well as in a number of human diseases. It is noted that the antigen-presenting function of this macrophage suffers when taking glucocorticosteroid preparations, at AIDS and large doses of ultraviolet radiation. Therefore, the investigation of the effect of UV-irradiated blood reinfusion on

the Langerhans cell will help to determine the possibilities of UV-irradiated blood therapy in treating a wide range of diseases, including AIDS, in the transplantation of organs and tissues. 163 refs.; 2 figs.

6676 (IA–1471, pp. 31) **Derived intervention levels of radionuclides in food following a major nuclear accident.** Gur, Y.; Schlesinger, T.; Shamai, Y. Israel Atomic Energy Commission, Tel Aviv (Israel). Aug 1992. In *Research laboratories annual report 1991*. [247] Order Number DE93609217. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. CIVIL DEFENSE/radiation protection; CONTAMINATION; DESIGN BASIS ACCIDENTS; FOOD; RECOMMENDATIONS

6677 (IAEA-TECDOC–664) **Establishment of source related dose constraints for members of the public. Interim report for comment.** International Atomic Energy Agency, Vienna (Austria). Sep 1992. [24] Order Number DE93609214. Source: OSTI; NTIS (US Sales Only); INIS.

The International Commission on Radiological Protection is proposing a new concept that it terms a "dose constraint". A dose constraint is an individual-related criterion applied to a single radiation source, and fixes an upper value for exposure of the critical group from that source. A dose restraint sets a ceiling on the levels of individual dose that can be considered in the optimization of radiological protection for a single source. 6 refs, 1 fig., 2 tabs.

6678 (IEN–28/91) **Radiation protection program for assistance of victims of radiation accidents.** Fajardo, P.W. (Instituto de Engenharia Nuclear (IEN), Rio de Janeiro, RJ (Brazil)); Costa Silva, L.H. da; Rosa, R. Instituto de Engenharia Nuclear (IEN), Rio de Janeiro, RJ (Brazil). Nov 1991. [13] (In Portuguese). Order Number DE93609218. Source: OSTI; NTIS (US Sales Only); INIS.

The principles aspects of a radiological protection program for hospitals in case of medical assistance to external and internal contaminated persons are showed. It is based on the experience obtained at Centro Medico Naval Marcilio Dias during the assistance to the victims of Goiania accident in 1987. This paper describes the basic infrastructure of a nursery and the radiation protection procedures for the access control of people and materials, area and personal monitoring, decontamination and the support activities such as calibration of radiation monitors and waste management. Is is also estimated the necessary radiation protection materials and the daily quantity of waste generated. (author).

6679 (INIS-BR–3009) **Study about excretion of ^{210} Po in urine.** Fonseca Azeredo, A.M.G. da. Universidade do Estado, Rio de Janeiro, RJ (Brazil). Centro Biomedico. 1988[90] (In Portuguese). Order Number DE93609177. Source: OSTI; NTIS (US Sales Only); INIS.

The urine of mines's workers are analysed to detect the presence of ^{210} Po. The results was compared with the workers and with a control population. Cigarettes samples was analysed two and confirmed the ^{210} presence. The control population individuals were divided in smokers and non smokers and them urine was investigated the influence of the smoke in the ^{210} Po excretion. (L.M.J.).

6680 (INIS-BR–3056) **Comparison between the distribution of the calculated dose and the media with thermoluminescent dosemeters ^{7} LiF in bladder tumor.** Araujo, A.M.C. de. Universidade Federal, Rio de Janeiro, RJ (Brazil). Inst. de Biofisica. 1974[109] (In Portuguese). Order Number DE93609227. Source: OSTI; NTIS (US Sales Only); INIS.

For the central plane of an assumed malignant tumor of the bladder, Cobalt - 60 treatment plans were calculated from published isodose curves. The calculation was done for the three field technique, unbalanced and balanced, and for 120 degree rotational therapy with wedge filter. A Rando-Alderson phantom and calibrated encapsulated ^{7} LiF dosimeters with a standard deviation better than 3% of each were used to verify the treatment plans. Furthermore the dose distribution to an assumed extension of the tumor and to the rectum were measured. (author).

6681 (INIS-GB–457) **First annual report 1988.** Independent Radiation Monitoring Scheme for Clwyd, Mold (United Kingdom). 1988[149] Order Number DE93609228. Source: OSTI; NTIS (US Sales Only); INIS.

Although there are no nuclear facilities in Clwyd, there are nuclear powers stations and reprocessing plants in neighbouring counties giving rise to concerns about raised radioactivity levels in Clwyd. Queries about the levels of radiation had to be researched and investigated from published government and generating board sources, which were often out of date. At the time of the Chernobyl reactor accident information was difficult to obtain and often issued too late for action to be taken by the local authorities. An independent radiation monitoring scheme for Clwyd was therefore set up at the beginning of 1988. The First Annual Report includes all the information relating to the running of the scheme together with all the results obtained within the county during 1988. The objectives of the report are to indicate the variation in levels of background radiation within the county and compare these results with those obtained by other local authorities, public utilities and government bodies. Air, beaches, sand and silt, seaweed, meat, milk and fish were sampled and radiation levels measured. (UK).

6682 (INIS-GB–458) **Second annual report 1989.** Independent Radiation Monitoring Scheme for Clwyd, Mold (United Kingdom). 1989[80] Order Number DE93609229. Source: OSTI; NTIS (US Sales Only); INIS.

A radiation monitoring scheme was established by the local authorities in Clwyd at the beginning of 1988. Samples of air, beach material, coastal sand and silt, seaweed, meat, fish and milk were taken from various locations within the county and analysed. Sampling, monitoring and analytical techniques are outlined. The results are included in the appendices and are compared with the results from 1988. No significant differences were found. The values found were within the limits expected and give no reason for concern. (UK).

6683 (INIS-GB–459) **Third annual report 1990.** Independent Radiation Monitoring Scheme for Clwyd, Mold (United Kingdom). 1990[70] Order Number DE93609230. Source: OSTI; NTIS (US Sales Only); INIS.

The Independent Radiation Monitoring Scheme for Clwyd began its monitoring programme in Clwyd in 1988. This is the third report on the results of the radiation monitoring carried out within Clwyd. It identifies any changes in techniques that have occurred in the last twelve months together with the latest monitoring and analytical data. Samples of air, beach materials, coastal sand and silt, seaweed, meat, fish and milk were taken from various locations within the county. No significant changes were found from the previous two years of monitoring. The levels of radioactivity were within the limits currently being detected throughout the United Kingdom. (author).

6684 (INIS-GB–460) **Fourth annual report 1991.** Independent Radiation Monitoring Scheme for Clwyd, Mold (United Kingdom). 1991[82] Order Number DE93609231. Source: OSTI; NTIS (US Sales Only); INIS.

The Independent Radiation Monitoring Scheme for Clwyd began its monitoring programme in Clwyd in 1988. This is the fourth report on the results of the radiation monitoring carried out within Clwyd. The historical reasons for the conception of the Radiation Monitoring Scheme are given in the First Annual Report together with the protocol of operation and detailed sampling and monitoring information. The fourth Annual Report identifies any changes in techniques that have occurred in the last twelve months together with the latest monitoring and analytical data. Samples of air, beach materials, coastal sand and silt, seaweed, meat, fish and milk were taken from various locations within the county. No significant charges in radiation levels were found when compared with data from previous years. The values have remained within the range currently being expected throughout the United Kingdom. (author).

6685 (INIS-mf–13387, pp. 848-856) **Effective dose evaluation of uranium mill workers at Jaduguda.** Jha, Giridhar (BARC Health Physics Unit, Jaduguda (India)); Raghavayya, M. Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences. 1991. [653] (CONF-8912172–: International symposium on uranium technology, Bombay (India), 13-15 Dec 1989). In *Proceedings of the international symposium on uranium*

technology [held at Bombay during 13-15 Dec 1989]. V. 2. Order Number DE93608801. Source: OSTI; NTIS (US Sales Only); INIS.

Routine monitoring of works areas (within and outside the ore processing facility) for external as well as internal dose assessment is carried out in order to evaluate the effect of uranium milling operations on the radiation exposure of occupational workers at Jaduguda. Method used for the dose measurement was deployment of personal radon dosimeter as area monitor in different units of the facility. Detectors used were CaSO (Dy) TLD's for the measurement of external gamma exposure and cellulose nitrate track detector for internal alpha exposure arising due to the inhalation of radon and its daughter products. This paper presents averages of the dose obtained over a measurement period of 3 years. Based on the average annual dose, work areas have been categorised into three groups viz 0-5 mSv, 5 -15 mSv and > 15 mSv. Personnel dose received in each category varied from 3.67±0.74, 8.42±2.48 and 25.93±10.76 mSv. respectively. Above values were used for calculating institution dose as well. (author). 4 refs., 2 tabs., 1 fig.

6686 (INIS-mf–13387, pp. 902-909) **Radiological and conventional safety aspects of machining operations of uranium ingots.** Joshi, V.B. (Bhabha Atomic Research Centre, Bombay (India). Health Physics Div.); Oommen, I.K.; Sengupta, S.; Iyengar, T.S. Department of Atomic Energy, Bombay (India). Board of Research in Nuclear Sciences. 1991. [653] (CONF-8912172–: International symposium on uranium technology, Bombay (India), 13-15 Dec 1989). In *Proceedings of the international symposium on uranium technology [held at Bombay during 13-15 Dec 1989]. V. 2.* Order Number DE93608801. Source: OSTI; NTIS (US Sales Only); INIS.

This paper describes the radiological and conventional aspects and basic criteria adopted in the planning and operation of machining of 112 uranium ingots at the Bhabha Atomic Research Centre, Bombay during 1988-1989. The machining was carried out to remove the hard coating of magnesium fluoride slag from the outer surface of the uranium ingot, which was formed during the reduction process. As part of feasibility studies, a preliminary tests was carried out and various parameters governing the airborne activity and fire hazard were generated. By optimising the operational safety facilities like use of appropriate protective equipment, ventillation facilities and sufficient and proper coolant flow, the airborne activity could be brought down to very low levels (fractions of DAC) and achieve ALARA principle in a practical way. The entire operation of machining of 2.2 m.te of the material was spread over a period of about six months. The collective dose for the whole operation was 1.85 person.mSv (0.185 manrem). The contribution from internal exposure as measured by bioassay techniques, was negligible. The operation was concluded with decontamination and waste disposal by following appropriate safety procedures. (author). 3 refs., 2 tabs.

6687 (INIS-mf–13395) **Determination of methyl methanesulfonate pretreatment effect in Drosophila melanogaster larvaes upon repair mechanisms in somatic cells.** Hernandez Paz, M. (Escuela de Biologia, Instituto de Ciencias y Artes de Chiapas (Mexico)). Instituto de Ciencias y Artes, Chiapas (Mexico). Escuela de Biologia. 1992[76] (In Spanish). Order Number DE93609142. Source: OSTI; NTIS (US Sales Only); INIS.

To make evident the existence of SOS repair mecanism in somatic cells, larvaes of drosophila melanogaster with MWH markers for females and FLR markers for males were used. This larvaes received a pretreatment with MMS at concentrations of 0.0007% and 0.0014% during 24 hours and latter a treatment with gamma rays at different dosis. SMART program was used to make stastistical evaluations. Small spots were observed which can have two origins. First could be damage in the last part of third stage in which cells are in last divisions and second could be the damage to larvaes in early stages in shich pretreatment with MMS cause lesions which prevent the reproduction of the cells. Also big spots were observed which presence is due to recombination. It was detected than the bigger the concentration of MMS and radiation dose, the bigger the induced damage. In some groups such observation was impossible may be to technical problems as relative humidity, out of phase in the growth of larvaes giving place that treatment were given in three stages. For this reasons it was impossible to discriminate if drosophila melanogaster is wheter or not capable to induce a repair mechanism (Author).

6688 (INIS-XN–412) **29 July 1991-Royal Order setting up a Higher Institute for Emergency Planning.** Belgium. 14 Sep 1991. [2] (In French, Dutch). Order Number DE93609772. Source: OSTI; NTIS (US Sales Only); INIS.

This Institute was set up in accordance with national legislation on protection against major industrial risks and Directive 89/618 Euratom on informing the general public about health protection measures to be applied and steps to be taken in the event of a radiological emergency. The Institute's duties include: organizing training for emergency planning and assistance; promoting the exchange of ideas on emergency planning between the authorities and operators of installations which could generate major risks, including nuclear installations; and disseminating adequate and regularly updated information to persons involved in emergency assistance on the risks they incur and the protection measures to be taken. (NEA).

6689 (INIS-XN–424) **International co-operation on decommissioning - Achievements of the NEA Co-operative programme 1985-1990.** Nuclear Energy Agency, 75 - Paris (France). 1992. [185] Order Number DE93609219. Source: OSTI; NTIS (US Sales Only); INIS.

Decommissioning of nuclear facilities is attracting a growing interest in all countries where an increasing number of plants are reaching the end of their operational life and will have to be decommissioned in the next few years. In response to this interest, the NEA set up in 1985 an international programme of technical co-operation between decommissioning projects in eight OECD countries. This report describes the programme and the participating projects, reviews the experiences accumulated during the first five-year term of this international undertaking, and discusses what remains to be done.

6690 (IS-M–730) **Macroscopic surface cleaning using a high repetition rate ultraviolet laser.** Pang, H.M.; Baldwin, D.; Edelson, M.C. Ames Lab., IA (United States). [1992]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-82. (CONF-9211142–1: IEEE lasers and electro-optics Society meeting, Boston, MA (United States), 15-20 Nov 1992). Order Number DE93002545. Source: OSTI; NTIS; INIS; GPO Dep.

The aim of the Ames Laboratory Laser Decontamination Project is to explore new decontamination methods to reduce waste volumes and achieve sufficiently high decontamination factors to permit the unrestricted release of metals for commercial use. This paper presents a discussion of recent experimental work designed to test the capabilities of ultraviolet lasers for large surface area (~ m^2) cleaning. The potential benefits of applying laser technology to decontamination are the elimination of solvents, the potential for remote operation to reduce exposure of personnel and expensive equipment to radiation hazards, and the minimization of secondary wastes. High-repetition rate lasers can clean large surfaces (~l m^2) in a reasonable amount of time. Proper selection of laser pulse energy, wavelength, repetition rate, and focusing lens is mandated to optimize process efficiency.

6691 (JAERI-M–92-110) **Verification of annual limits on intake and concentration limits for radionuclides produced in accelerator facilities.** Suga, Shinichi (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Togawa, Orihiko; Yamaguchi, Yukichi; Kawai, Katsuo; Oshino, Masao; Tamura, Tutomu. Japan Atomic Energy Research Inst., Tokyo (Japan). Jul 1992. 81p. (In Japanese). Order Number DE93754291. Source: OSTI; NTIS; INIS.

Many of the radionuclides produced by Accelerators are not compiled in ICRP Publication 30. Annual limits on intake (ALI_s) of the 78 radionuclides were calculated by other authors using a Code System, PIEDEC-R. Also, they calculated the derived concentration limits on air, exhaust air and draining water etc. compatible with such derived limits in domestic regulations. Then, a proposal was made to verify their results before publication. To respond to the proposal, annual limits on intake of 12 radionuclides selected from

the above 78 radionuclides were calculated by DOSDAC, the code system developed in JAERI for the assessment of dose coefficient for intake and the results were compared in the present report. In conclusion, the ratios of the calculation result of ALI_a by DOSDAC to that by PIEDEC-R were within the range from -8% to +18%, and so, agreement was well provided that the data for the radionuclides are sufficiently arranged in Evaluated Nuclear Structure Data File (ENSDF). As for Ba-129, of which data are not sufficient in ENSDF, relevant nuclear data were supplemented and its ALI_a were calculated. No problem was found on calculation of derived limits in the report of referred authors, and used parameters and treatment of fractions were considered adequate. (author).

6692 (KFK–4749) **WOLGA 2.1 - a FORTRAN-77-code for calculation of the short-term gamma submersion dose rate caused by gamma radiation of a radioactive off-gas plume.** Huebschmann, W.; Papadopoulos, D.; Baer, M.; Honcu, S. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Meteorologie und Klimaforschung; Kernforschungszentrum Karlsruhe GmbH (Germany). Hauptabteilung Sicherheit. Aug 1992. 38p. (In German). Order Number DE93750660. Source: OSTI; NTIS (US Sales Only); INIS.

The WOLGA 2.1 computer code calculates the short-term gamma submersion dose rate caused by the radioactive off-gas plume of a single source located at a point near the ground. It is assumed that the off-gas plume maintains its direction and form and that a double Gaussian function describes the distribution of radioactivity within the plume. The activity is assumed to be released from a stack or a building. The buildup factor and the mass attenuation coefficient in air are interpolated - dependent on the gamma energy - from recent results of calculations. The dose rate is calculated for up to 600 defined locations or for a polar grid so that isodose charts can be drawn. The subdivision of the plume into a finite number of volume elements can be chosen freely. It can be so finely divided that the error of the result obtained is less than about 3%. The gamma dispersion factor normalized to a wind velocity of 1 m/s is shown in diagrams for 6 dispersion categories, for emission levels from 0 up to 200 m and for a gamma energy of 1 MeV. These diagrams are consistent with the Allgemeine Verwaltungsvorschrift referring to Para. 45 of the German Radiation Protection Order. (orig.).

6693 (KURRI-TR–363) **Proceedings of the symposium on 'radiation research in life science': DNA repair genes and mutagenesis.** Ikushima, Takaji (ed.). Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst. May 1992. 81p. (In Japanese). (CONF-9201125–: Symposium on 'radiation research in life science', Kumatori (Japan), 16-17 Jan 1992). Order Number DE93754137. Source: OSTI; NTIS; INIS.

This issue is the collection of the papers presented at the title conference. The 2 of the presented papers are indexed individually. (J.P.N.).

6694 (LA–12429-PR) **Health physics, 1991 progress report.** Wahl, L. (comp.). Los Alamos National Lab., NM (United States). Dec 1992. 45p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93004287. Source: OSTI; NTIS; INIS; GPO Dep.

At Los Alamos National Laboratory, radiation protection services are provided by HS-1, -4, and -12, and technical support is provided to Laboratory groups that work with significant quantities of fissile material by HS-6. The mission of all these groups is to protect Laboratory workers, the public, and the environment from radiation associated with Laboratory operations. In this report, 1991 radiation protection performance trends are presented. These data show that, in general, the collective external dose equivalent quantities from penetrating (gamma, x-ray, and neutron) radiation and from nonpenetrating (beta and low-energy photon) radiation decreased over most of 199 1. In general, the number of confirmed contaminations of skin and personal clothing increased in the first quarter of 1991 but decreased markedly in subsequent quarters. Finally, there were no confirmed intakes (through ingestion or inhalation) of radioactive material at eight facilities in all of 1991. The 1991 radiation protection activities of the Laboratory, conducted at both the Nevada Test Site and at Los Alamos, are presented and discussed. These activities include external dosimetry, internal dosimetry, radiation-monitoring instrumentation, sample analyses, workplace monitoring, radioactive air emissions management, nuclear criticality safety, radiological emergency response, radiological training, radiological audits and investigations, and radiological records. This report details routine activities, including any significant changes and improvements in 1991; additional activities, including special investigations, studies, and reviews; publications and presentations; and professional activities, including professional memberships, training received, and conferences attended.

6695 (LA-UR–92-3651) **Prediction of health risks from accidents: A comprehensive assessment methodology.** MacFarlane, D.R. (Los Alamos National Lab., NM (United States)); Yuan, Y.C. Los Alamos National Lab., NM (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9211129–1: International Atomic Energy Agency (IAEA) technical meeting on guidelines on probabilistic consequence assessment, Vienna (Austria), 9-13 Nov 1992; N–6-92-R208). Order Number DE93003811. Source: OSTI; NTIS; INIS; GPO Dep.

We have developed two computer programs to predict radiation risks to individuals and/or the collective population from exposures to accidental releases of radioactive materials. When used together, these two codes provide a consistent, comprehensive tool to estimate not only the risks to specific individuals but also the distribution of risks in the exposed population and the total number of individuals within a specific level of risk. Prompt and latent fatalities are estimated for the exposed population, and from these, the risk to an average individual can be derived. Uncertainty in weather conditions is considered by estimating both the "median" and the "maximum" population doses based on the frequency distribution of wind speeds and stabilities for a given site. The importance of including all dispersible particles (particles smaller than about 100 μm) for dose and health risk analyses from nonfiltered releases for receptor locations within about 10 km from a release has been investigated. The dose contribution of the large particles (> 10 μm) has been shown to be substantially greater than those from the small particles for the dose receptors in various release and exposure conditions. These conditions include, particularly, elevated releases, strong wind weather, and exposure pathways associated with ground-deposited material over extended periods of time.

6696 (LA-UR–92-3700) **Bubble dosimetry experience at Los Alamos National Laboratory.** Hoffman, J.M.; Harvey, W.F.; Foltyn, E.M. Los Alamos National Lab., NM (United States). [1992]. 32p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9211124–2: Harshaw/quality systems (HS) 1992 thermoluminescent dosimetry (TLD) user symposium, San Antonio, TX (United States), 9-13 Nov 1992). Order Number DE93003776. Source: OSTI; NTIS; INIS; GPO Dep.

The BD-100R bubble dosimeters as calibrated at LANL are significantly more sensitive than the manufacturer has reported, due to differences in calibration conditions. However, the dosimeters are a useful tool in measuring neutron dose over a wide range of neutron energies. In addition, the use of individual sensitivity correction factors are stable and reproducible. The dosimeters offer good sensitivity and have a small lower-limit-of-detection (less than 1 mrem for the Model 12.0) and allow for nearly real-time monitoring of neutron dose. The temperature compensation now available on the BD-100R Bubble Detector will remove some of the error in results and will make the evaluation of the dosimeter less difficult. Although the BDRSeries II evaluation system is effective as currently available, there are significant improvements to the usability of the system which could be made. Field use of the bubble dosimeter is an excellent ALARA tool which has been used at LANL to identify specific "high dose" processes and make immediate improvements and reductions in dose. Use of bubble dosimeters has verified track-etch dosimetry work at LANL which shows a reduction in NCFs is warranted.

6697 (PNWD–1980-05-HEDR) **Hanford Environmental Dose Reconstruction Project: Monthly report.** Cannon, S.D.; Finch, S.M. (comps.). Pacific Northwest Lab., Richland, WA (United States). Oct 1992. 21p. Sponsored by USDOE, Washington, DC (United States); Department of Health and Human Services,

Washington, DC (United States). DOE Contract AC06-76RL01830. Contract 200-92-0503(CDC)/18620(BNW). Order Number DE93003209. Source: OSTI; NTIS; INIS; GPO Dep.

The objective of the Hanford Environmental Dose Reconstruction (HEDR) Project is to estimate the radiation doses that individuals and populations could have received from nuclear operations at Hanford since 1944. The independent Technical Steering Panel (TSP) provides technical direction. The project is divided into the following technical tasks. These tasks correspond to the path radionuclides followed from release to impact on humans (dose estimates):Source Terms, Environmental Transport, Environmental Monitoring Data, Demography, Food Consumption, and Agriculture, and Environmental Pathways and Dose Estimates.

6698 (PNWD–2028-HEDR) **Documents containing operating data for Hanford separations processes, 1944–1972: Hanford Environmental Dose Reconstruction Project.** Gydesen, S.P. Pacific Northwest Lab., Richland, WA (United States). Sep 1992. 31p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Contract 200-92-0503(CDC)/18620(BNW). Order Number DE93000842. Source: OSTI; NTIS; GPO Dep.

The purpose of this letter report is to identify documents that record batch, daily, or selected monthly separations processes operating information at the Hanford Site for the years 1944-1972. The information found in these documents is needed to develop the source terms necessary to make dose estimates. The documents have been identified, located, declassified if necessary, evaluated, and made available to the HEDR Project in general, the HEDR Task 03 (Source Terms) in particular, and the public. Complete bibliographic citations and some sample pages from the Hanford separations processes documents are included.

6699 (PNWD–2047-HEDR) **Status of document search and data quality objective efforts.** Gydesen, S.P. Pacific Northwest Lab., Richland, WA (United States). Oct 1992. 20p. Sponsored by Public Health Service, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93003216. Source: OSTI; NTIS; INIS; GPO Dep.

The purpose of this letter report is to document the status of the identification, search, retrieval, evaluation, declassification and availability of (1) Hanford-Site-originated operating information necessary to reconstruct radiation doses and (2) monitoring information indicating concentrations of radioactive materials in the environment. All information needed to date to reconstruct the radiation doses has been identified, sought, retrieved, evaluated, declassified, and made available. Any data needed in the future that have not yet been found will be sought using the same search tree method used to identify the Hanford-Site-originated documents up to now. This search tree method has ensured that the data quality objective of completeness is met. Because there was a centralized list of documents for which we have technical indices the documents through 1964 have been identified, and the document collections are considered as complete as possible. The collection of documents from 1965–1972 is complete for monthly average data but not to the same extent as for the years 1944–1964 where daily and sometimes hourly data are often available and for which a subject index is readily available. From 1965–1972 there were multiple contractors, each maintaining a separate document system with no detailed subject index for retrieval purposes. A HEDR Information Resources Tracking System (HIRTS) database has been established of all documents identified as being of potential interest and/or use to dose reconstruction. The HIRTS contains more than 6000 citations with bibliographic information on each report, document number(s), author(s), title, date, document form (hard copy or microfilm), number of pages, location, public availability, and names of HEDR Project and TSP staff who have requested copies.

6700 (PSI–122) **Background characteristics of various etched track neutron dosemeters.** Azimi-Garakani, D. (Paul Scherrer Inst. (PSI), Villigen (Switzerland)); Wernli, C. Paul Scherrer Inst. (PSI), Villigen (Switzerland). Jun 1992. [14] Order Number DE93609232. Source: OSTI; NTIS; INIS.

The results of background characteristics and sensitivities of various types of polyallyldiglycolcarbonate (PADC) are presented and compared with each other. This study is within the framework of the collaboration programme organized by EURADOS-CENDOS. The commercially available polymeric detectors known as CR-39 and extensively used for neutron dosimetry were supplied by five different manufacturers. For each type/thickness of material, two or three sheets were sampled. Each sheet divided into six equal areas and from each, 4 background and 2 sensitivity detectors were taken and the total of 512 samples were tested. The sensitivity was determined for normally incident bare ^{252}Cf neutrons. The samples were etched with the four-step electrochemical etching and a post chemical etch treatment. The highest sensitivity of 0.2 cm^{-2} μSv^{-1} with the lowest average background of about 150 μSv for a single sheet was found. The minimum detectable dose equivalent (MDDE) taken as three standard deviations of background was found to be 153 μSv. (author) 4 figs., 4 tabs., 12 refs.

5602 Thermal Effects

6701 (SA-PUB–3/92, pp. 156-161) **Response of the boreal forest ecosystem to climatic change and its silvicultural implications.** Kellomaeki, S. (Joensuu Univ. (Finland). Faculty of Forestry); Haenninen, H.; Karjalainen, T.; Laitinen, K.; Pajari, B.; Peltola, H.; Repo, T.; Strandman, H.; Vaeisaenen, H. Academy of Finland, Helsinki (Finland). 1992. In *The Finnish research programme on climate change: Progress report.* 310p. Order Number DE93752870. Source: OSTI; NTIS.

SILMU Research Programme.

The future mean annual temperature is expected to be two to three degrees centigrade higher than at present, the temperature rise being the greatest in winter with a consequent lengthening of the thermal growing season. Furthermore, the annual precipitation will nearly double, the increase being greatest during winter. The climatic change will increase the uncertainty of the future management of the forest ecosystem. This study aims at outlining the ecological and silvicultural implications of climatic change with regard to how the expected climatic change will possibly modify the functioning and structure of the boreal forest ecosystem, and how the silvicultural management of the forest ecosystem should be modified in order to maintain sustainable forest yield in changing climatic conditions. The total project includes several subprojects, each of them being separately described below.

6702 (SA-PUB–3/92, pp. 162-167) **Physiological and genetic adaptation of forest trees to climatic changes.** Beuker, E. (Finnish Forest Research Institute, Punkaharju (Finland)); Koski, V. Academy of Finland, Helsinki (Finland). 1992. In *The Finnish research programme on climate change: Progress report.* 310p. Order Number DE93752870. Source: OSTI; NTIS.

SILMU Research Programme.

Modeling and studying trees (usually seedlings) under controlled environments are two well known approaches to study the effects of climate on forest trees. A third approach might be the investigation of old provenance experiments. In the oldest provenance experiments in Finland trees have been grown for over 60 years in a climate, different from that where the trees are expected to be adapted to. This is why these experiments might give useful information, especially on the long term effects of climatic changes on forest trees. In this project a series of observations are being carried out in old provenance experiments on characters which are known to be influenced by climate. The main aim for the 1990 program was to carry out pilot studies to test and improve the methods, but also to collect the first data to look for trends to be further investigated during the following years. During 1991 and 1992 the main data will be collected and analyzed. In 1993 the analyzes should be completed and the final reports should be written.

6703 (SA-PUB–3/92, pp. 168-173) **The effect of climate on the phenology of perennial plant species.** Heikinheimo, M. (Finnish Meteorological Institute, Helsinki (Finland). Climatology Division); Lappalainen, H. Academy of Finland, Helsinki (Finland). 1992. In *The Finnish research programme on climate change: Progress report.* 310p. Order Number DE93752870. Source: OSTI; NTIS.

SILMU Research Programme.

This study was initiated to investigate further the relation of climate and the phenological development of wild plants. The study

is based on a wide collection of phenological records organized and published by the Finnish Scientific Society. Additional field investigations are being conducted during the study to develop consistent methods for observing phenological events. The specific goals of the project are: to study the timing of leaf and flower bud emergence, fruiting and leaf colouring in relation to observed climate, to select climate variables and methods for estimating the occurrence of phenological events using standard climatological data, and to participate in the organization of a new phenological observation network, by co-ordinating routine observation activities and by studying the observation methods.

6704 (SA-PUB–3/92, pp. 181-186) **The impact of climatic change on cereal crops in Finland.** Pehu, E. (Helsinki Univ. (Finland). Dept. of Crop Production); Karvonen, T.; Kleemola, J.; Peltonen-Sainio, P. Academy of Finland, Helsinki (Finland). 1992. In *The Finnish research programme on climate change: Progress report.* 310p. Order Number DE93752870. Source: OSTI; NTIS.

SILMU Research Programme.

The plant physiology part of our research program was initiated in collaboration with D. Lawlor fall 1990. The objectives of the study were to investigate the effect of continuous elevated, atmospheric CO_2 concentration on photosynthesis, crop development and chloroplast ultrastructure in wheat and barley. More specifically the measurements included: plant development, the amount of soluble protein and Rubisco in leaf tissue, Rubsico enzyme activity, cell size, chlorophyll content, structure of the grana and stroma thylakoids and photosynthetic efficiency in two atmospheric CO_2 concentrations (350ppm,700ppm). The electronmicrographs of the chloroplast ultrastructures have been analysed by a morphometer and there are significant differences in the size of starch granules, lipid globules, and stacking of thylakoids.

6705 (SA-PUB–3/92, pp. 189-192) **Carbon balance of peatlands and global change: Summary.** Laine, J. (Helsinki Univ. (Finland). Dept. of Forestry Ecology); Paeivaenen, J. Academy of Finland, Helsinki (Finland). 1992. In *The Finnish research programme on climate change: Progress report.* 310p. Order Number DE93752870. Source: OSTI; NTIS.

SILMU Research Programme.

The aims of the 'SUOSILMU' research project are twofold: to study the role of peatlands in the balances of various greenhouse gases (namely, CO_2. CH_4 and N_2O). This involves carbon and nutrient studies in virgin and drained peatland ecosystems and to determine how the predicted changes in atmospheric chemistry and the consequent climatic changes will affect the structure and functioning of peatlands, both virgin and those under land-use.

6706 (SA-PUB–3/92, pp. 193-198) **Dynamics of greenhouse gases in virgin and managed peatlands.** Silvola, J. (Joensuu Univ. (Finland). Dept. of Biology); Alm, J. Academy of Finland, Helsinki (Finland). 1992. In *The Finnish research programme on climate change: Progress report.* 310p. Order Number DE93752870. Source: OSTI; NTIS.

SILMU Research Programme.

The aim of this study is to examine the dynamics of three gases (CO_2, CH_4, N_2O) in peatlands, which are in the virgin state or utilized in different ways. CO_2 production of peat is measured both in the field and laboratory. In cooperation with the subproject CH_4, and N_2O measurements are made in the same study sites. On the basis of measurements a model on gas fluxes will be generated for study sites. The effects of the changing environment will be estimated by changing parameters in the model.

6707 (SA-PUB–3/92, pp. 199-204) **Emissions of methane and nitrous oxide from peat ecosystems.** Martikainen, P.J. (National Public Health Institute, Kuopio (Finland). Dept. of Environmental Microbiology); Nykaenen, H.; Silvola, J. Academy of Finland, Helsinki (Finland). 1992. In *The Finnish research programme on climate change: Progress report.* 310p. Order Number DE93752870. Source: OSTI; NTIS.

SILMU Research Programme.

Climatic change may decrease level of ground water in the high-latitudes and cause remarkable changes in the gas Ruxes because of the increased oxygen content in uppermost soil layers. Presently this phenomenon is taking place after draining of peatland e.g. for forestry. Drained peatlands can be utilized in evaluation the effects of increased peat aeration on gas fluxes. CH_4 CO_2, and N_2O are produced with very different microbiological mechanisms. Therefore- the environmental changes (e.g. moisture, deposition, fertilization) have different effect on the processes responding the production and consumption of these gases. In this SUOSILMU project the fluxes of CH_4, and N_2O in situ both in virgin and drained peatlands will be measured, and the factors regulating the fluxes will be determined. Because of the method applied CO_2 is also included to the measurements. There is lack in studies where the fluxes of CH_4, CO_2 and N_2O from peatlands are measured simultaneously. The mechanisms responding the gas fluxes and their regulatory factors are studied also in laboratory experiments. The modelling of CH_4, and N_2O fluxes will be based on the results of this project.

6708 (SA-PUB–3/92, pp. 237-242) **The role of leaching in the material balance of peatlands.** Sallantaus, T. (Water and Environment District of Tampere, Tampere (Finland)). Academy of Finland, Helsinki (Finland). 1992. In *The Finnish research programme on climate change: Progress report.* 310p. Order Number DE93752870. Source: OSTI; NTIS.

SILMU Research Programme.

The aim of this study is, on the one hand, to produce information needed in other subprojects of SUOSILMU seeking to elucidate the material balance of peatlands and the processes which regulate this balance, and, on the other hand, to utilize the results of SUOSILMU to study the role of various processes in regulating the runoff water quality and the leaching rates from natural and drained peatlands. The main objectives are to determine: the role of leaching or retention in the long term material balance of mires; the primary regulators in the leaching process and how climatic change affects the leaching rates from peatlands. In the case of areas drained for forestry, the final objective is to be able to predict the long-term leaching behaviour by taking into account the original peat quality and nutrient stores, the rate of peat decay, biomass growth and its effect on peat nutrient stores, production of new litter, deposition and climatic variables.

6709 (SA-PUB–3/92, pp. 245-249) **Development of a climate generator for Finland.** Posch, M. (Water and Environmental Research Institute, Helsinki (Finland)). Academy of Finland, Helsinki (Finland). 1992. In *The Finnish research programme on climate change: Progress report.* 310p. Order Number DE93752870. Source: OSTI; NTIS.

SILMU Research Programme.

Climatic data are needed as input for many kinds of ecological models. Although some meteorological data are eventually collected during the monitoring period at a specific site, these data are often not sufficient for running a model for a longer time period or applying it at a different site. The lack of adequate meteorological input data becomes even more apparent when one wants to apply an ecological model on a regional scale. And when modeling an ecosystem's response to a changing climate, procedures are needed to generate meteorological input data with statistical properties reflecting a (predicted) climatic change. The objective of this project is to develop a climate generator for Finland, i.e. a database of parameters together with procedures (computer programs) for generating time series of climatological variables which have the same (or at least similar) statistical characteristics as the original observations. The basic idea of the climate generator is to replace the huge amount of (daily) observations of selected meteorological variables by a few parameters describing the statistical properties of the distributions of these values. The advantage of such a tool is that there is no limit to the length of time series generated, and the statistical characteristics of the selected variables can be changed in a desired manner. The climate generator can be used to produce the meteorological input data for (ecological) models, both for the present climate and for possible future climates consistent with the large-scale climatic changes predicted by general circulation models.

6710 (SA-PUB–3/92, pp. 261-268) **Response of northern forest plants to the pressure of air pollution and climatic change.** Laine, K. (Oulu Univ. (Finland). Dept. of Botany); Huttunen, S.; Kauppi, M.; Ohtonen, R. Academy of Finland, Helsinki

(Finland). 1992. In *The Finnish research programme on climate change: Progress report.* 310p. Order Number DE93752870. Source: OSTI; NTIS.

SILMU Research Programme.

Many climatic scenarios predict a temperature increase which will be higher in northern Europe than in many other areas, and this can be expected to influence many processes in plants growing in the northern regions. The aim of the terrestrial ecosystems research programme at the Department of Botany, University of Oulu, is to study the effects of the changing climate and air pollution on the functioning of terrestrial ecosystems and plants in northern Finland and to conduct experiments on the adaptation of northern plants to greenhouse gas emissions. The combination of a great number of environmental stress factors with air pollutants makes the present problem extremely complex to study in natural populations, so that more controlled, long-term experimental conditions are needed. It is for this purpose that are experiment field with 12 open top chambers has been constructed for use in the present research programme. The programme is being carried out to study the long-term synergistic effects of air pollutants and changing climatic conditions on the northern forest ecosystem, and thus to increase our knowledge of climate change and its consequences for the fragile northern ecosystems. Ecological, physiological, morfhological and biochemical methods are being used to study the responses of forest trees, dwarf shrubs, lichens and soil biology to environmental changes. The research programme is divided into the four subprojects: Effects of environmental changes on the allocation of resources in forest dwarf shrubs; air pollutants, climate and forest trees; susceptibility of lichens to air pollution and their use as bioindicators, and the effects of gaseous pollutants on soil biology. Descriptions these subprojects and their hypotheses are given below, and some results are presented in the references quoted.

6711 (SA-PUB–3/92, pp. 269-273) **Anthropogenic environmental changes and the risk of forest insect outbreaks.** Neuvonen, S. (Turku Univ. (Finland). Dept. of Kevo Subarctic Research Institute). Academy of Finland, Helsinki (Finland). 1992. In *The Finnish research programme on climate change: Progress report.* 310p. Order Number DE93752870. Source: OSTI; NTIS.

SILMU Research Programme.

The increase in nitrogen and sulphur deposition over large areas and the predicted climatic changes present a great challenge to forest entomologists. The processes acting insect population densities work in so large spatial scales that it is generally not feasible to do experiments in that scale. To estimate the effects of anthropogenic environmental changes on the risks caused by pest organisms is possible by revealing the basic processes important for density changes, and using that information in simulation models. It is obvious that no single model can explain the population dynamics of all herbivorous insects, and that a specific change in the environment has variable effects on different insect species. For example, insects sucking plant sap benefit more easily than leaf-chewing insects from changes in host quality caused by air pollution. In the following discussed is population dynamics of two defoliating insect species, European pine sawfly (Neodiprion sertifer) and autumnal moth (Epirrita autumnata), with the aim to illustrate connections to anthropogenic environmental changes. Herbivorous insects have an unfavourable trophic position between plants with variable and often suboptimal foliage quality and various kinds of natural enemies. The relative importance of host quality vs. natural enemies varies among different herbivore species: natural enemies (e.g. shrews predating cocoons and the nucleopolyhedrosis virus killing larvae) are probably more important for European pine sawfly than variation in foliage quality, while foliage quality and delayed inducible resistance have a prominent role in the population dynamics of autumnal moth.

5603 Chemicals Metabolism and Toxicology

Refer also to citation(s) 5698, 5790, 6137, 6481, 6483, 6494, 6495, 6496, 6515, 6523, 6621, 6654

6712 (BNL–48062) **The effects of prolonged growth in elevated CO_2 concentrations in the field on the amounts of different leaf proteins.** Nie, G.Y. (Brookhaven National Lab., Upton, NY (United States)); Long, S.P. Brookhaven National Lab., Upton, NY (United States). Sep 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9208155–3: 9. international congress on photosynthesis, Nagoya (Japan), 30 Aug - 5 sep 1992). Order Number DE93002940. Source: OSTI; NTIS; GPO Dep.

Atmospheric CO_2 concentration (Ca) is expected to rise to double pre-industrial concentrations within the next century. Increased Ca may stimulate photosynthetic CO_2 uptake (A) in C_3 species because of the low affinity of Rubisco for CO_2 and by inhibition of RubP oxygentation. Several controlled environment studies have suggested that this potential stimulation may be offset by decreased Rubisco contents and activities in leaves developed at elevated C_a, which can be related to decreased photosynthetic capacity in these leaves. This decreased capacity may be an artifact of restriction of below-ground organ development, and hence sink-capacity, imposed by pot size. Four species grown over two or more years in elevated C_a in the field are used to address when changes in Rubisco content are also observed when plants are grown with elevated Ca in the field without restriction on rooting volume and whether Rubisco is the only major leaf protein to show change in quantity in plants grown in elevated ca over prolonged periods.

6713 (ETDE-mf–93744366) **Health effects of diesel exhaust gases. 5 years of research promotion.** Oekologische Forschung. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Forschungszentrum Juelich GmbH (Germany). Projekttraeger Biologie, Energie, Oekologie; Bundesministerium fuer Forschung und Technologie, Bonn (Germany). 1992 62p. (In German). Order Number DE93744366. Source: OSTI; NTIS (US Sales Only).

It was the aim of the research work described and discussed here to improve the scientific prerequisites for the evaluation of dangers to human health from emission of diesel exhaust gases. The question actually to be clarified was the relationship between the particles contained in diesel exhaust gases and the effects of their inhalation by humans. The experiments were carried out with uniform baseline material prepared according to an especially developed procedure (diesel exhaust particulate, complete extract of diesel exhaust particulate and fractions isolated from this), commercial titanium dioxide particles and technical grade particulate of unvarying composition and quality. All these materials were examined for their effects in rats and mice as well as in cultured cells. In conjunction with other immission data needing to be confirmed by further measurements the results of this research project will provide a basis for more comprehensive assessments of dangers to health not only due to diesel particulate emissions but also through soot particles and hardly soluble fine dusts from other sources of emission. All of the eight contributions to this volume are available individually. (orig./MG).

6714 (ETDE-mf–93744366, pp. 21-30) **Inhalation experiments in animals to elucidate the tumour-promoting potential of exhaust gases of diesel engines and two test dusts.** Heinrich, U. (Fraunhofer-Inst. fuer Toxikologie und Aerosolforschung, Hannover (Germany)); Fuhst, R.; Mohr, U. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Forschungszentrum Juelich GmbH (Germany). Projekttraeger Biologie, Energie, Oekologie; Bundesministerium fuer Forschung und Technologie, Bonn (Germany). 1992. 62p. (In German). In *Health effects of diesel exhaust gases. 5 years of research promotion.* Order Number DE93744366. Source: OSTI; NTIS (US Sales Only).

It was found that not only diesel exhaust particulate, but also technical grade particulate practically free from any organic impurifications as well as titanium dioxide particles caused lung tumours in rats after having been inhaled. The tumour rate increased in proportion to particle concentration, while it appeared to be unrelated to the type of particle inhaled. No lung tumours were detected at the lowest test concentration of diesel exhaust particles (0.8 milligrammes/1 m^3 air). This is regarded as evidence to prove that the internal parts of the diesel exhaust particles constitute the decisive tumour-promoting factors, which means that the main culprit here must be the particle core rather than the relatively small amount of polycyclic aromatic hydrocarbons. Carcinogenic effects specific to

diesel exhaust particles were not observed. Experiments in mice carried out under the same test conditions as those for the rats failed to reveal increased pulmonary tumour rates. (orig./MG).

6715 (ETDE-mf–93744366, pp. 31-38) **Experimental study of the in-vitro transformation of airway epithelial cells by exhaust gases of automobiles.** Mohr, U. (Medizinische Hochschule Hannover (Germany). Inst. fuer Experimentelle Pathologie); Riebe-Imre, M. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Forschungszentrum Juelich GmbH (Germany). Projekttraeger Biologie, Energie, Oekologie; Bundesministerium fuer Forschung und Technologie, Bonn (Germany). 1992. 62p. (In German). In *Health effects of diesel exhaust gases. 5 years of research promotion.* Order Number DE93744366. Source: OSTI; NTIS (US Sales Only).

In connection with this project a number of compounds found in diesel exhaust gases of diesel engines were studied for their effects on cultured lung cells from animals and humans. The tests were performed on epithelial cells. It could be shown that diesel exhaust particulate extract influences the metabolism of foreign substances in cultured cells. The extract stimulated the activity of certain enzymes, which are known as 'mixed-function' oxygenases. This effect failed to occur, when the tests were carried out with the fraction of polycyclic aromatic hydrocarbons isolated from the extract. Moreover, diesel exhaust particulate extract caused more damage to airway epithelial cells of humans and hamsters than did the fraction of polycyclic aromatic hydrocarbons. The formation of micronuclei was, however, induced by both substance mixtures. Under the experimental conditions chosen for this study, solely the PAH fraction led to an in-vitro transformation of normal cells into cancer cells. Airway epithelial cells of hamsters were more sensitive in this respect than those obtained from humans. Diesel exhaust particles hardly had any cytotoxic effects on the epithelial cells of humans and hamsters, even though transformations of those cells were seen to occur in vitro. Further investigations with titanium dioxide and Printex 90 confirmed these findings. (orig./MG).

6716 (ETDE-mf–93744366, pp. 39-42) **Examination of diesel exhaust fractions for genotoxic and cell-transforming properties using the model of Syrian hamster embryo fibroblasts as well as pulmonary cells.** Schiffmann, D. (Wuerzburg Univ. (Germany). Inst. fuer Toxikologie); Henschler, D. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Forschungszentrum Juelich GmbH (Germany). Projekttraeger Biologie, Energie, Oekologie; Bundesministerium fuer Forschung und Technologie, Bonn (Germany). 1992. 62p. (In German). In *Health effects of diesel exhaust gases. 5 years of research promotion.* Order Number DE93744366. Source: OSTI; NTIS (US Sales Only).

Diesel exhaust extract and fractions of polycyclic aromatic hydrocarbons (PAH), oxidised PAH and nitro-PAH isolated from this were to be investigated for their genotoxic effects and cell-transforming potential. The investigations were performed on cultured fibroblasts of Syrian hamster embryos and lung cells of humans. The test system used was determined by following biological endpoints: (A) induction of micronuclei; (B) induction of DNA excision repair; (C) induction of transformation. Diesel exhaust extract was found to induce the formation of micronuclei in fibroblasts from Syrian hamster embryos. The various fractions isolated from this proved to have a considerable cytotoxic effect. These results were largely consistent with the findings revealed in lung cells of human embryos. It was further found that diesel exhaust extract and the related PAH fraction triggered transformation processes in fibroblasts of Syrian hamster embryos. Such transformations of normal cells into cancer cells were to a lesser extent observed for the fractions of nitro-PAH and oxidised PAH, even though their cytotoxic effects turned out to be much more pronounced. With the aid of immunocytochemical procedures it was possible to prove that the micronuclei contained relatively large numbers of chromosomes. This is evidently due to the fact that some components of diesel exhaust gases bring about cellular chromosome depletion. (orig./MG).

6717 (ETDE-mf–93744366, pp. 43-46) **The role of microsomal peroxidases and monooxidases from the liver and lungs in the mutagenic activation of exhaust gas components in vitro.** Kind, R. (Wuerzburg Univ. (Germany). Inst. fuer Toxikologie); Wild, D.; Henschler, D. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Forschungszentrum Juelich GmbH (Germany). Projekttraeger Biologie, Energie, Oekologie; Bundesministerium fuer Forschung und Technologie, Bonn (Germany). 1992. 62p. (In German). In *Health effects of diesel exhaust gases. 5 years of research promotion.* Order Number DE93744366. Source: OSTI; NTIS (US Sales Only).

Diesel exhaust particulate extract, fractions isolated from latter and pure model substances were tested to find out whether they can be transformed into reactive metabolites through the action of metabolic enzymes. For this purpose, enzymes from the group of peroxides were contrasted with monooxidases. The ^{32}P-postlabelling technique was used for the detection of reactions with DNA. Tests in bacterial cultures pointed to mutagenic effects not only for diesel exhaust particulate extract and the fractions isolated from this but also for some of the model substances after having been activated by monooxigenases. No such effects could be observed for any of the test substances following activation by peroxidases. Benzo(a)pyrene, which was one of the model substances, and diesel exhaust particulate extract were activated by peroxidases to be transformed into highly responsive metabolites that reacted with DNA. Contrary to previous expectations, metabolites of benzo(a)pyrene formed after the addition of peroxidase were not seen to bind to (intracellular) bacterial DNA. The activation of metabolic processes by peroxidases, which could be proven here, may be a decisive factor in the influence of diesel exhaust particles on the lungs. (orig./MG).

6718 (ETDE-mf–93744366, pp. 47-52) **Interindividual differences in reactions to benzo(a)pyrene as a model of genotoxic effects of polycyclic hydrocarbons in exhaust gases of automobiles.** Ruediger, H.W. (Hamburg Univ. (Germany). Ordinariat fuer Arbeitsmedizin). GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Forschungszentrum Juelich GmbH (Germany). Projekttraeger Biologie, Energie, Oekologie; Bundesministerium fuer Forschung und Technologie, Bonn (Germany). 1992. 62p. (In German). In *Health effects of diesel exhaust gases. 5 years of research promotion.* Order Number DE93744366. Source: OSTI; NTIS (US Sales Only).

It is generally assumed that polycyclic aromatic hydrocarbons in exhaust gases of automobiles are, at least to a considerable extent, to be made responsible for the occurrence of genotoxic effects. Tests in human cell cultures have shown that the reactions to any pollutant may differ between individuals. This is explained by the fact that the activaton and inactivation of those pollutants vary according to individual metabolic conditions and also by differences in the efficacy of genetic repair mechanisms. The investigations additionally provided evidence that the measured biological effects of the pollutants were linked with a hereditary disposition for cancer of the lungs. (orig./MG).

6719 (ETDE-mf–93744609) **Sputum-diagnostic biomonitoring of optional precancerous stages of bronchial carcinoma in a risk group exposed to asbestos fiber dust. Results of a pilot study.** Forschungsbericht Asbest. Schriftenreihe des Hauptverbandes der gewerblichen Berufsgenossenschaften. Woitowitz, H.J. (Giessen Univ. (Germany). Inst. und Poliklinik fuer Arbeits- und Sozialmedizin); Etz, P.; Boecking, A.; Lange, H.J. Haputverband der Gewerblichen Berufsgenossenschaften e.V., St. Augustin (Germany). May 1989 62p. (In German). Order Number DE93744609. Source: OSTI; NTIS (US Sales Only).

163 employees of an insulating firm processing mainly crocidolite agreed to an industrial medicine internal medical check-up. The minimum exposure time was one day, whith a median of 3 years and a maximum time of 41 years. The period since the first occupational exposure to asbestos was between 3 and 49 years. After having been given a detailed medical explanation, 112 of the 163 examined employees agreed to undergo a sputum examination. In total 411 specimens reached the cytopathological diagnostics. 44 of 93 specially addressed employees underwent a follow-up examination after about one year. 162 further sputum specimens could be diagnosed in this manner. The specimen fraction without cells of the low respiratory tract was approx. 24% during the first examination and 27% during the follow-up examination. Established tumour-cell-negative findings without squamous metaplasias or

dysplasias were obtained in approx. 14% during the first examination and in approx. 16% during the follow-up examination. Minor dysplasias were proved during the first examination in approx. 8%, during the follow-up examination in approx. 5%. Optional precancerous stages were found during the first examination in approx. 8%, during the follow-up examination in approx. 2%. Sputumcytological examinations were carried out complemantarily to this in 17 patients with past asbestos fiber dust exposure at the job. Optionally precancerous cells were found in one case, tumor cells were found positively in another case. The present possibilities and limits of the methodology are shown with regard to the insured person groups which are known at the central registration office for asbestos dust workers of the General Association of the commercial trade cooperative associations; consequences are derived for the decision-making committees of the commercial trade cooperative associations. (orig./MG).

6720 (ETDE-mf–93750598) **Development of a special method for the dust epidemiology of coal mines: Determination of transition probabilities for various stages of coal-workers pneumoconiosis (Phase 1).** Morfeld, P.; Kampmann, B.; Vautrin, H.J.; Piekarski, C. Institut fuer Arbeitswissenschaften der RAG, Dortmund (Germany); Koeln Univ. (Germany). Inst. und Poliklinik fuer Arbeitsmedizin, Sozialmedizin und Sozialhygiene; Ruhrkohle AG, Duisburg (Germany). Bergwerk Walsum. 1990 48p. (In German). Order Number DE93750598. Source: OSTI; NTIS (US Sales Only).

Development of a special method for the dust epidemiology of coalmines: determination of transition probabilities for various stages of coalworkers' pneumoconiosis (phase I). It was the aim of this study to describe and analyse the course of development of coalworkers' pneumonconiosis and its dependence on the length of underground time, calendar time and age as the time variables chosen. In all, the model analyses of the course of disease pointed to risk reductions that were related to calendar times, even if the miner's age at the beginning of his underground occupation was additionally taken into account. The described model of the developmental process of disease, which formed part of a general stochastic model, was found to be useful in the analysis of transitions from CWSP = 0/0 to stages of CWSP > 0/1 (and interim stages). This means that the probability of occurrence of coalworkers' simple pneumonconiosis could thus be determined. Further refinements to the method appear recommendable so as to permit transition probabilities to be determined for the individual stages of CWSP and PMF. (orig./MG).

6721 (ETDE-mf–93750680) **Hazardous substance information: Asbestos.** Schulz, T. Thueringer Ministerium fuer Soziales und Gesundheit, Erfurt (Germany). 1992 7p. (In German). Order Number DE93750680. Source: OSTI; NTIS (US Sales Only).

Recently asbestos loads in school buildings, multi-storey buildings, large halls and the private sector have been increasingly reported on. Therefore this publication wants to inform about the risks in connection with asbestos and give advice for a reasonable behaviour. This concerns products such as asbestos cement, asbestos in stoves, weakly bonded asbestos, asbestos in sealing compounds and coatings. (orig./MG).

6722 (ETDE-mf–93750690) **Investigation into the influence of heavy metals (especially Cd, Zn) on the cambium activity of Central European forest trees (beech, spruce). Final report.** Forschungsberichte zum Forschungsprogramm des Landes Nordrhein-Westfalen 'Luftverunreinigungen und Waldschaeden'. Breckle, W.; Hagemeyer, J.; Verlage, L.; Kamradt, B.; Schaefer, H.; Schlagintweit, K.; Perk, M.; Luelfsmann, A.; Sahrhage, E.; Brinkmann, S.; Luehrmann, D.; Lohrmann, D.; Heppel, T. Bielefeld Univ. (Germany). Abt. Oekologie; Ministerium fuer Umwelt, Raumordnung und Landwirtschaft des Landes Nordrhein-Westfalen, Duesseldorf (Germany). Mar 1992 147p. (In German). Contract FP30. Order Number DE93750690. Source: OSTI; NTIS (US Sales Only).

The influence of heavy metals on the activity of the cambium - i.e., the annual wood increment - is measured in the field and in cultivation experiments. In both cases, the results were as follows: slighter tree rings due to Cd and Zn, correlation of stem wood Cd and Zn contents with the ones in the soil, distinctly higher Cd sensitivity of spruce as compared to beech (50 μmol Cd respectively) > 1500 μmol Cd x (kilogramme of soil TG)$^{-1}$, and a distinctly stronger effect of heavy metals during the second vegetation period. In some sites in North-Rhine-Westphalia, forestry is expected to make less profit because of severe heavy metal pollution of soil. (UWA).

6723 (GSF–4/92) **Ecological approaches of environmental chemicals. Proceedings.** Meszaros, I.; Gebefuegi, I.; Loerinci, G. (eds.). GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany). Inst. fuer Oekologische Chemie. 1992. 443p. (CONF-9104400–: International symposium on ecological approaches of environmental chemicals, Debrecen (Hungary), 15-17 Apr 1991). Order Number DE93750725. Source: OSTI; NTIS (US Sales Only); INIS.

Out of 61 contributions, 26 were individually recorded. Apart from the pollution of the environment with traditional gaseous pollutants, particular attention is given to organic halogen compounds, insecticides and heavy metals. Much space is given to the biological accumulation of metals and organic substances in algae, fish and crop plants like maize, wheat and fodder plants, as well as to the biological or abiotic degradation and detoxification of pollutants. The extent of pollution in various Hungarian sites is described and some possibilities for mitigating harmful effects are pointed out (fertilization, land cultivation measures). Moreover, some physiological effects of pollutants on plants and aquatic animals (production of protective substances, chloroses, growth inhibitions, etc.) are described. (UWA).

6724 (GSF–4/92, pp. 8-14) **Research into the causes of oak decay in Hungary.** Berki, I. (Meteorological Dept., L. Kossuth Univ., Debrecen (Hungary)). GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany). Inst. fuer Oekologische Chemie. 1992. (CONF-9104400–: International symposium on ecological approaches of environmental chemicals, Debrecen (Hungary), 15-17 Apr 1991). In *Ecological approaches of environmental chemicals. Proceedings.* 443p. Order Number DE93750725. Source: OSTI; NTIS (US Sales Only); INIS.

The work studies the causes of oak die-back in Hungary. Tree injury manifests itself as chlorosis, undersized leaves and withering and seems to be due, surprisingly, to nitrogen deficiency. The low contents of nitrogen (especially nitrate) in soil are ascribed to soil acidification induced by air pollutants and drought, with the drought presenting an additional impediment to N uptake by the roots. N fertilization results in larger leaves and higher chlorophyll contents. (UWA).

6725 (GSF–4/92, pp. 31-44) **Ecophysiological responses of Tortula ruralis upon cadmium and lead treatments.** Csintalaln, Z. (Dept. of Botany and Plant Physiology, Agricultural Univ. of Goedoelloe (Hungary)); Meenks, J.L.D.; Tuba, Z. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany). Inst. fuer Oekologische Chemie. 1992. (CONF-9104400–: International symposium on ecological approaches of environmental chemicals, Debrecen (Hungary), 15-17 Apr 1991). In *Ecological approaches of environmental chemicals. Proceedings.* 443p. Order Number DE93750725. Source: OSTI; NTIS (US Sales Only); INIS.

The main objective of this study was to examine whether ecophysiological responses of the moss Tortula ruralis (which is used in Hungary as bioindicator of air pollution) can be used to indicate heavy metal pollution. Cadmium and lead were applied to T. ruralis in final concentrations of 10^{-5}, 10^{-4}, 10^{-3} and 10^{-2} M. During two weeks exposure time, total photosynthetic pigment content decreased from 2.49 mg g^{-1} dw in the control, to 1.63 and 1.58 mg for respectively 10^{-3} mM Cd and Pb; the corresponding decreases in net photosynthesis were 84 and 80%, respectively. Dark respiration was reduced in some cases, but enhanced in others lead-treated T. ruralis showed cases lower remoistening dark respiration rates (R_{dmax}). Cd-treated, but not lead-treated plants had lower amounts of carbohydrates (mainly reduced starch content). T. ruralis is highly responsive to even the short-therm (2 weeks) and low concentration heavy metal treatment and the examined

physiological parameters - mainly net photosynthesis and remoistening CO_2-exchange - prove to be suitable for bioindication of heavy metal pollution. (orig./UWA).

6726 (GSF–4/92, pp. 45-50) **Forest damage surveys in Hungary.** Csoka, P. (Forest Management Planning Service of the Ministry of Agriculture, Budapest (Hungary)). GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany). Inst. fuer Oekologische Chemie. 1992. (CONF-9104400–: International symposium on ecological approaches of environmental chemicals, Debrecen (Hungary), 15-17 Apr 1991). In *Ecological approaches of environmental chemicals. Proceedings.* 443p. Order Number DE93750725. Source: OSTI; NTIS (US Sales Only); INIS.

An overall balance of forest decline surveys in Hungary is presented. It reveals distinct differences between tree species as to degree of defoliation and chlorosis. The severity of injury to oak-trees, especially Quercus petraea and Carpinus, emerges very clearly, while conifers have suffered less harm. As compared to 1989, damage was distinctly aggravated in 1990 in all categories (except dead trees). In sampling, equal heed was taken of the age structure of Hungarian forest stands as of the relative distribution of species. (UWA).

6727 (GSF–4/92, pp. 51-61) **Studies on the possibility of interpreting bioindication in water-bodies of different loadings in NE-Hungary.** Devai, G. (Lehrstuhl fuer Oekologie, Univ. L. Kossuth, Debrecen (Hungary)); Devai, I.; Czegeny, I.; Harman, B.; Wittner, I.; Fuerjesi, K. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany). Inst. fuer Oekologische Chemie. 1992. (In German). (CONF-9104400–: International symposium on ecological approaches of environmental chemicals, Debrecen (Hungary), 15-17 Apr 1991). In *Ecological approaches of environmental chemicals. Proceedings.* 443p. Order Number DE93750725. Source: OSTI; NTIS (US Sales Only); INIS.

On ecological basis, the environmental effects can be most reliably revealed by means of the indications (sometimes alarm signals) of living organisms. Our studies were concentrated on the possibility of using model organism groups of different life forms and life modes for the investigation of pollution in natural resp. artificial sample areas, with special regard to heavy metals and chlorinated hydrocarbons. The samples were collected from differently loaded ares. The results unequivocally showed, that a given pollutant was accumulated in varying quantities by organisms with different taxonomical status, life forms and life modes. In the cases examined, in addition to specificity according to species, element resp. compound, specificity according to developmental form and water-body are also important features for pollutant accumulation. It is essential to include in the list of water quality parameters a new parameter, on the basis of which conclusions can be drawn concerning the 'endangered state' of the biota (perniciousness) caused by the accumulation of pollutants in living organisms. (orig./UWA).

6728 (GSF–4/92, pp. 62) **The ability of calcium to reduce the CS-137 penetration through plant cuticles.** Ertel, J. (GSF-Institut fuer Strahlenschutz, Neuherberg (Germany)). GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany). Inst. fuer Oekologische Chemie. 1992. (CONF-9104400–: International symposium on ecological approaches of environmental chemicals, Debrecen (Hungary), 15-17 Apr 1991). In *Ecological approaches of environmental chemicals. Proceedings.* 443p. Order Number DE93750725. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. DIFFUSION/leaves; DIFFUSION/cesium 137; CALCIUM; PLANTS; DIFFUSION; LEAVES; FRUIT TREES; PERMEABILITY; SURFACES; POTASSIUM; CELL MEMBRANES

6729 (GSF–4/92, pp. 101-107) **Change in contents of a few trace and toxic elements in different corn hybrids during the growing season.** Gyoeri, Z. (Faculty of Agronomy, Agricultural Univ. of Debrecen (Hungary)); Kovacs, B.; Lanyi, A.; Loch, J.; Nagy, J. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany). Inst. fuer Oekologische Chemie. 1992. (CONF-9104400–: International symposium on ecological approaches of environmental chemicals, Debrecen (Hungary), 15-17 Apr 1991). In *Ecological approaches of environmental chemicals. Proceedings.* 443p. Order Number DE93750725. Source: OSTI; NTIS (US Sales Only); INIS.

Maize as the most important forage crop in Hungary is frequently grown on land fertilized with sewage sludge. Therefore, this work investigates the heavy metal content of plants during the course of a vegetation period. Both the final heavy metal content at harvesting and the trace of the rates of uptake over the period of vegetation are found to be very dependent on the specific variety. Differences in heavy metal contents of 30% for copper, 50% for zinc and 20% for manganese are found at harvesting. Normally, the contents of heavy metal (gramme per kilogramme of dry mass) are highest in young plants and decline during the course of the vegetation period. (UWA).

6730 (GSF–4/92, pp. 108-122) **The effect of different factors on the trace element intake of wheat and corn.** Gyoeri, Z. (Faculty of Agronomy, Agricultural Univ. of Debrecen (Hungary)); Ruzsanyi, L.; Lesznyak, J.; Kovacs, B.; Lanyi, A. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany). Inst. fuer Oekologische Chemie. 1992. (CONF-9104400–: International symposium on ecological approaches of environmental chemicals, Debrecen (Hungary), 15-17 Apr 1991). In *Ecological approaches of environmental chemicals. Proceedings.* 443p. Order Number DE93750725. Source: OSTI; NTIS (US Sales Only); INIS.

The heavy-metal content of Hungarian maize and wheat cultures is investigated with respect to cultivation measures (fertilization, crop rotation, irrigation, working technique). After fertilization, the authors discover changes in the distribution of strontium and copper between the ears and stems of wheat. Irrigation induces lowered heavy metal contents in wheat for biennial rotation (wheat and maize) and increased heavy metal contents for triennial rotation (soy-bean, wheat, maize). Strontium and manganese contents go up in all three cultures with fertilization. Phosphate fertilization lowers the zinc uptake and yield of maize. Upon irrigation, the copper content increases during blooming while the lead content goes down and increases again at the time of ripening only. The data underline the importance of cultivation measures for the heavy-metal content of plants. (UWA).

6731 (GSF–4/92, pp. 205-214) **Intake, behaviour and effects environmental chemicals.** Kettrup, A. (GSF-Forschungszentrum fuer Umwelt und Gesundheit GmbH, Inst. fuer Oekologische Chemie, Neuherberg (Germany)); Guenther, W.; Rose, E.; Lintelmann, J. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany). Inst. fuer Oekologische Chemie. 1992. (CONF-9104400–: International symposium on ecological approaches of environmental chemicals, Debrecen (Hungary), 15-17 Apr 1991). In *Ecological approaches of environmental chemicals. Proceedings.* 443p. Order Number DE93750725. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. POLYCYCLIC AROMATIC HYDROCARBONS/quantitative chemical analysis; POLYCYCLIC AROMATIC HYDROCARBONS/water pollution monitors; RIVERS; GROUND WATER; SEASONAL VARIATIONS; WATER TREATMENT

6732 (GSF–4/92, pp. 220-236) **The ecotoxicological relevance of chlorinated hydrocarbons.** Koch, R. (Bayer AG, WV-UWS, Leverkusen (Germany)). GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany). Inst. fuer Oekologische Chemie. 1992. (CONF-9104400–: International symposium on ecological approaches of environmental chemicals, Debrecen (Hungary), 15-17 Apr 1991). In *Ecological approaches of environmental chemicals. Proceedings.* 443p. Order Number DE93750725. Source: OSTI; NTIS (US Sales Only); INIS.

The complexity of ecotoxicological assessments of atmospheric and water pollution with halogenated hydrocarbons is pointed out. It is made clear that for most of these substances, too little is known about the sources, the actual nuisance to biological and abiotic objects - which is not to be directly derived from the ambient concentration -, chemical and biotic transformations of substances, and dose/time relations. The reactivity and persistence of this class of substances and their biological degradation are referred to in great detail; their biological and geological accumulation and toxicity are discussed. Production rates of anthropogenic halogenated

hydrocarbons and concentrations in the Rhine water and air are indicated, 'natural' substances - produced by the algae Asparagopsis - listed, and octanol/water partition coefficients mentioned. (UWA).

6733 (GSF–4/92, pp. 238-248) **Occurrence and fate of chemicals in ecosystems.** Korte, F. (Technische Univ. Muenchen, Inst. fuer Chemie, Freising-Attaching (Germany)). GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany). Inst. fuer Oekologische Chemie. 1992. (CONF-9104400–: International symposium on ecological approaches of environmental chemicals, Debrecen (Hungary), 15-17 Apr 1991). In *Ecological approaches of environmental chemicals. Proceedings.* 443p. Order Number DE93750725. Source: OSTI; NTIS (US Sales Only); INIS.

The paper deals with the problem of the release of organic compounds into the environment, focussing on insecticides. Production and deposition rates are indicated, and the fate of the substances is discussed. By means of pentachloronitrobenzene in onions, the complexity of the biotic and abiotic conversion processes is illustrated. Interest is directed mainly to abiotic conversions taking place without need for supporting radiation, for instance mineralization of Mekka-sand-adsorbed CCL_2F_2. Even inside living cells, such non-enzymatic, abiotic processes can take place, for instance in the presence of radioactive species of oxygen or other radicals. In addition, data on the biological accumulation of numerous organic substances in algae and fish (for instance, several thousand-fold enrichment), their retention in rats, and their mineralization are presented. (UWA).

6734 (GSF–4/92, pp. 249-253) **Element content of ruderal weeds used as accumulating indicators in some industrial districts of Hungary.** Kovacs, M. (Dept. of Botany and Plant Physiology, Agricultural Univ. of Goedoelloe (Hungary)); Turcsanyi, G.; Kaszab, L.; Koltay, A.; Penksza, K.; Nagy, L. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany). Inst. fuer Oekologische Chemie. 1992. (CONF-9104400–: International symposium on ecological approaches of environmental chemicals, Debrecen (Hungary), 15-17 Apr 1991). In *Ecological approaches of environmental chemicals. Proceedings.* 443p. Order Number DE93750725. Source: OSTI; NTIS (US Sales Only); INIS.

As Hungary does not monitor environmental pollution emitted by industrial sources, the authors analysed some soil and plant samples from areas of heavy industry (aluminium, works, iron works, power plants, refineries, metallurgical works) for their heavy metal content. In soil, heavy metal contents (especially lead and zinc) were up to 50 times higher than the Hungarian limiting values for maximum pollutant emission. Similar findings are reported for the heavy metal contents of the leaves of Plantago, Polygonum, Reseda lutea and Robinia pseudoacacia referred to pollutant limits for fodder. (UWA).

6735 (GSF–4/92, pp. 274-285) **Reactions of trees to air pollutants.** Langebartels, C. (Inst. fuer Biochemische Pflanzenpathologie, GSF Muenchen, Neuherberg (Germany)); Ernst, D.; Heller, W.; Sandermann, H. Jr. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany). Inst. fuer Oekologische Chemie. 1992. (CONF-9104400–: International symposium on ecological approaches of environmental chemicals, Debrecen (Hungary), 15-17 Apr 1991). In *Ecological approaches of environmental chemicals. Proceedings.* 443p. Order Number DE93750725. Source: OSTI; NTIS (US Sales Only); INIS.

A general overview of the impact of the toxic gases ozone and sulfur dioxide on trees is given. Observations in the field are contrasted with experimental studies on the effects of toxic gas in climate chambers. In the same way, a distinction is made between acute symptoms during transient, high stress and chronic stress, whose effect on plant development frequently lacks phenomena immediately visible. The difference in stress to hardwood (leaf trees) and conifers is dealt with. The symptoms produced in spruces and beech-trees are expressly described. The uptake and detoxification of gaseous pollutants are described. In this context, the kinetics of the synthesis of protective substances against ozone by pines is mentioned. The only recently detected effect of ozone on DNA transcription is explained. (UWA).

6736 (GSF–4/92, pp. 286-292) **Effect of increasing doses of chromium uptake of lolium multi-florum L. in multifactorial experiments.** Loch, J. (Agrarwissenschaftliche Univ., Landwirtschaftliche Fakultaet, Debrecen (Hungary)); Gyoeri, Z.; Vago, I. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany). Inst. fuer Oekologische Chemie. 1992. (In German). (CONF-9104400–: International symposium on ecological approaches of environmental chemicals, Debrecen (Hungary), 15-17 Apr 1991). In *Ecological approaches of environmental chemicals. Proceedings.* 443p. Order Number DE93750725. Source: OSTI; NTIS (US Sales Only); INIS.

Chromium uptake by the grass Lolium multiflorum and its variation due to liming and nitrogen application is investigated by vessel experiments using two different types of soil (haploboroll and sandy soil). Even the highest application of 100 mg of chromium per kilogramme of soil is found to have no significant effect on yield, although the plants' chromium contents increase in parallel with those of the soil. Nitrogen fertilization results in somewhat lower chromium contents owing to enhanced plant growth, while liming does not influence yield but lowers chromium content distinctly - presumably because it results in a higher pH value of the soil, enhancing the adsorption of chromium to soil constituents. (UWA).

6737 (GSF–4/92, pp. 293-304) **Environmental fate of pollutants and their transformation and transport.** Mansour, M. (GSF-Institut fuer Oekologische Chemie, Freising-Attaching (Germany)); Mamouni, A.; Schmitt, P. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany). Inst. fuer Oekologische Chemie. 1992. (CONF-9104400–: International symposium on ecological approaches of environmental chemicals, Debrecen (Hungary), 15-17 Apr 1991). In *Ecological approaches of environmental chemicals. Proceedings.* 443p. Order Number DE93750725. Source: OSTI; NTIS (US Sales Only); INIS.

The photodegradation of carbetamide, and metoxuron in water in the presence of ozone, hydrogen peroxide and oxygenated aqueous suspensions of titanium dioxide has been investigated. Photolysis kinetics were determined using solutions irradiated with a laboratory light source >290 nm and suntest. The time required for 90 per cent destruction was correlated to the concentration of the pesticides. The effect of the H_2O_2 concentration on the rate of carbetamide oxidation was determined. Several photo-products were isolated and identified by spectroscopic methods. The results suggest that the degradation pathways of these compounds in the presence of UV-H_2O_2 and UV-TiO_2, are hydroxylations of the aromatic ring. UV-ozonation rapidly photooxidized all pesticides. The openings of the aromatic ring were observed, which produces lower molecular weight carboxylic acids, and further photooxidation which eventually converts the acids to CO_2, H_2O and HNO_3. (orig.).

6738 (GSF–4/92, pp. 306-313) **Effects of soil acidification on the physiology of sessile oak trees.** Meszaros, I. (Botanical Dept., Lajos Kossuth Univ., Debrecen (Hungary)). GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany). Inst. fuer Oekologische Chemie. 1992. (CONF-9104400–: International symposium on ecological approaches of environmental chemicals, Debrecen (Hungary), 15-17 Apr 1991). In *Ecological approaches of environmental chemicals. Proceedings.* 443p. Order Number DE93750725. Source: OSTI; NTIS (US Sales Only); INIS.

Leaf pigment content of healthy and diseased sessile oak trees was studied in forest stands in different distances from chemical industry in North Hungary. For the damaged trees considerable degradation of photosynthetic pigment composition was found which indicated destroyed photosynthetic capacity. The changes in the pigment content concentrated, however, on the upper part of tree crowns. The total chlorophyll content decreased in average with 50 % in the leaves of damaged trees compared with the healthy ones, the ratio of chlorophyll a to chlorophyll b. however, did not practically changed. The total carotenoids reduced less than that of the chlorophylls in the leaves of damaged trees and the ratio of chlorophylls to carotenoids decreased considerably. (orig.).

6739 (GSF–4/92, pp. 314-318) **Accumulation of pesticides and chlorinated hydrocarbons in brown forest soils.** Meszaros, I. (Botanical Dept., Lajos Kossuth Univ., Debrecen (Hungary)); Loerinci, G.; Gebefuegi, I. GSF - Forschungszentrum fuer Umwelt

und Gesundheit GmbH, Neuherberg (Germany). Inst. fuer Oekologische Chemie. 1992. (CONF-9104400--: International symposium on ecological approaches of environmental chemicals, Debrecen (Hungary), 15-17 Apr 1991). In *Ecological approaches of environmental chemicals. Proceedings.* 443p. Order Number DE93750725. Source: OSTI; NTIS (US Sales Only); INIS.

Within the framework of forest decline research, the question for the possible effect of organic halogen compounds on the development of plants arose. The pollution of the soils of two Hungarian forest stands (a relatively unpolluted control stand and a stand exposed to high air pollution from a nearly emittor) with this type of compound was compared. In the polluted site, the organic chemicals were 1.8-fold the amount of what had been measured in the control stand (pesticides, PCBs, HCHs, HCB, HC, aldrin, dieldrin), with bHCH being increased almost tenfold and some PCBs (B.180, B.140) almost 2.5-fold. The impact of pollution on this scale on the ecosystem is completely unknown so far. (UWA).

6740 (GSF–4/92, pp. 334) **Nutrient concentrations and ultrastructural changes of Scots pine needles in the forest area in Southwestern Finland.** Palomaeki, V. (Univ. of Kuopio, Ecological Lab., Dept. of Environmental Sciences (Finland)); Raitio, H. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany). Inst. fuer Oekologische Chemie. 1992. (CONF-9104400--: International symposium on ecological approaches of environmental chemicals, Debrecen (Hungary), 15-17 Apr 1991). In *Ecological approaches of environmental chemicals. Proceedings.* 443p. Order Number DE93750725. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. PINES/nutrients; PINES/ultrastructural changes; PINES/air pollution; PINES/nutritional deficiency; PINES; NUTRIENTS; LEAVES; PLANT GROWTH; CHLOROSIS; AGE DEPENDENCE; CALCIUM; MAGNESIUM; MEMBRANES; NITROGEN; PHOSPHORUS; CHLOROPLASTS; MITOCHONDRIA; CYTOPLASM; ACID RAIN; PLANT DISEASES

6741 (GSF–26/91) **Second status seminar of the 'Bavarian Project Group on Research into the Effect of Environmental Pollutants (PBWU)' on the major research area 'forest decline'. Proceedings.** Reuther, M. (GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany). Projektgruppe Bayern zur Erforschung der Wirkung von Umweltschadstoffen (PBWU)); Kirchner, M.; Roesel, K. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Bayerisches Staatsministerium fuer Landesentwicklung und Umweltfragen, Muenchen (Germany). Aug 1991. 553p. (In German). (CONF-9102189--: 2. status seminar of Projektgruppe Bayern zur Erforschung der Wirkung von Umweltschadstoffen (PBWU) on forest decline, Neuherberg (Germany), 4-6 Feb 1991). Order Number DE93742762. Source: OSTI; NTIS (US Sales Only).

Out of the 38 lectures presented in this volume on work by PBWU (Bavarian Project Group on Research into the Effect of Environmental Pollutants), 33 are individually recorded. Investigations in stands in the areas Wank (Calcareous Alps), Fichtelgebirge and Bavarian Forest taking altitudinal gradients particularly into account (ozone pollution) are contrasted with experimental pollution investigations, physiological investigations and mathematical modellings. Data presented comprise measurements of air pollutants; meteorological parameters; vegetation investigations; vapour exchange measurements in the field (photosynthesis/water budget); the investigation of pollutant uptake into the cuticula and by the inner part of leaves; changes in the levels of sulfur compounds, secondary metabolites, monoterpenes, phenols, nutritive elements (C,N,K,P); classifications of forest decline phenomena; root and soil investigations; measurements and modellings of detoxification mechanisms, etc. (UWA).

6742 (GSF–26/91, pp. 15-40) **Deposition, conversion and effect of air pollutants in mountain forest ecosystems of the Alpine region. Concept of research in the Calcareous Alps (Wank/Kramer near Garmisch-Partenkirchen), a main area of research of PBWU.** Rennenberg, H. (Fraunhofer-Inst. fuer Atmosphaerische Umweltforschung (IFU), Garmisch-Partenkirchen (Germany)); Reuther, M. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Bayerisches Staatsministerium fuer Landesentwicklung und Umweltfragen, Muenchen (Germany). Aug 1991. (In German). (CONF-9102189--: 2. status seminar of Projektgruppe Bayern zur Erforschung der Wirkung von Umweltschadstoffen (PBWU) on forest decline, Neuherberg (Germany), 4-6 Feb 1991). In *Second status seminar of the 'Bavarian Project Group on Research into the Effect of Environmental Pollutants (PBWU)' on the major research area 'forest decline'. Proceedings.* 553p. Order Number DE93742762. Source: OSTI; NTIS (US Sales Only).

According to the results of the forest damage inventories of recent years, approximately one third of mountain forest in the Bavarian (Calcareous) Alps exhibits "distinct damage" (more than 25 per cent loss of needles). Forest rejuvenation is often prevented by cattle grazing in the forest and abundancy of game. Near Garmisch-Partenkirchen, more than 50 per cent of forest trees show distinct thinning of crowns; this is most conspicuous 300 to 800 metres above the level of the valley. This fact, the low concentrations of SO_2 and NO_x in medium ranges of the Calcareous Alps and the basicity of the ground tell against direct damage due to these classic air pollutants. It is assumed that the current amount of tropospheric photochemical oxidants constitutes a factor of stress to the mountain forest ecosystem in the Alpine region. A predisposing or trigger effect of site and climate related factors, such as nutrition condition, exposure, water supply, late frost events etc., must be considered. (orig./UWA).

6743 (GSF–26/91, pp. 65-76) **Evaluation of forest damage in the research area 'Wank' in the Bavarian Alps in 1987-1990.** Moessmer, R. (Bayerische Forstliche Versuchs- und Forschungsanstalt, Muenchen (Germany)); Traenkner, H.; Schuster, M. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Bayerisches Staatsministerium fuer Landesentwicklung und Umweltfragen, Muenchen (Germany). Aug 1991. (In German). (CONF-9102189--: 2. status seminar of Projektgruppe Bayern zur Erforschung der Wirkung von Umweltschadstoffen (PBWU) on forest decline, Neuherberg (Germany), 4-6 Feb 1991). In *Second status seminar of the 'Bavarian Project Group on Research into the Effect of Environmental Pollutants (PBWU)' on the major research area 'forest decline'. Proceedings.* 553p. Order Number DE93742762. Source: OSTI; NTIS (US Sales Only).

From 1987 to 1990 the condition of the forest in the research area 'Wank' was investigated by evaluation of defoliation and yellowing by interpretation of infrared color aerial photographs for the entire research area. On seven test plots of special interest, a terrestrial interpretation was carried out additionally. Between 1987 and 1989 in the entire area remarkable decline of damage of pine, fir and - in a lower extent - spruce was determined. In 1989 spruce, exposed to the west, were more damaged than those exposed to the south. Regarding the altitudes, two main damage zones were found between 800 to 1000 meters and 1300 to 1400 meters above sea level. A well-founded comparison of the results of the previous years demands for an enlarged data basis because of the high differences in altitude. The results of the terrestrial interpretation in the seven areas along the altitude profile do not reveal essential changes in the average percentage of defoliation between 1987 and 1989. The last survey in summer 1990 cannot be compared with the results of the previous years because of the numerous windfalls caused by the springstorms. (orig./UWA).

6744 (GSF–26/91, pp. 77-85) **Comparative evaluation of total plant species combination at sites with different deposition in the Bavarian Alps.** Rehder, H. (Technische Univ. Muenchen (Germany). Lehrstuhl fuer Botanik); Still, F. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Bayerisches Staatsministerium fuer Landesentwicklung und Umweltfragen, Muenchen (Germany). Aug 1991. (In German). (CONF-9102189--: 2. status seminar of Projektgruppe Bayern zur Erforschung der Wirkung von Umweltschadstoffen (PBWU) on forest decline, Neuherberg (Germany), 4-6 Feb 1991). In *Second status seminar of the 'Bavarian Project Group on Research into the Effect of Environmental Pollutants (PBWU)' on the major research area 'forest decline'. Proceedings.* 553p. Order Number DE93742762. Source: OSTI; NTIS (US Sales Only).

From 1986 to 1989 a range of infrared aerophoto studies had been carried out on the mountain Wank in order to investigate the

forest decline of the Northern Calcareous Alps. A total of 205 random test areas of this aerophoto studies have been localized on the mountain. Within this test areas the floristic communities and other important ecological parameters were examined for to be compared statistically with the quantitative distribution of the decline of the Norway spruce. With this method it was possible to point out, that differences in the vitality of Picea abies (L.) are depending on several ecological features. (orig.).

6745 (GSF–26/91, pp. 125-137) **Field experiments for studying the direct effects of ozone and other photooxidants on the gas exchange of spruces.** Dunkl, M. (TU Muenchen-Weihenstephan, Freising (Germany). AG Biophysik); Knoppik, D. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Bayerisches Staatsministerium fuer Landesentwicklung und Umweltfragen, Muenchen (Germany). Aug 1991. (In German). (CONF-9102189–: 2. status seminar of Projektgruppe Bayern zur Erforschung der Wirkung von Umweltschadstoffen (PBWU) on forest decline, Neuherberg (Germany), 4-6 Feb 1991). In *Second status seminar of the 'Bavarian Project Group on Research into the Effect of Environmental Pollutants (PBWU)' on the major research area 'forest decline'. Proceedings.* 553p. Order Number DE93742762. Source: OSTI; NTIS (US Sales Only).

No direct effects of photooxidants and ozone, respectively, could be found by methods of gas exchange measurements present in open air investigations of old spruce trees. This statement is valid only for fully developed twigs. During the first two months of needle development no experiments were done. Developing needles of potted spruce trees showed in the labaratory an enhanced sensitivity to ozone. (orig.).

6746 (GSF–26/91, pp. 139-149) **Reduction of stomatal control capacity by air pollutants.** Maier-Maercker, U. (Muenchen Univ., Lehrstuhl fuer Forstbotanik (Germany)). GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Bayerisches Staatsministerium fuer Landesentwicklung und Umweltfragen, Muenchen (Germany). Aug 1991. (In German). (CONF-9102189–: 2. status seminar of Projektgruppe Bayern zur Erforschung der Wirkung von Umweltschadstoffen (PBWU) on forest decline, Neuherberg (Germany), 4-6 Feb 1991). In *Second status seminar of the 'Bavarian Project Group on Research into the Effect of Environmental Pollutants (PBWU)' on the major research area 'forest decline'. Proceedings.* 553p. Order Number DE93742762. Source: OSTI; NTIS (US Sales Only).

A hypothesis is put forward which proposes a specific disturbance of the control capacity of the stomata directly effected by air pollutants. The necessity for a dynamic functional test for a differential diagnosis is deduced from the differing course of reaction under changed humidity conditions in damaged and healthy twigs. A test of this type was carried out in the field in combination with the pure air/ambient air comparison of gas exchange (KOCH) in spruce in the lower Bavarian Forest. Under defined conditions of drought stress, the pure air twig reduces its transpiration more strongly than the ambient air twig. The influence of the climatic situation on the damage is shown. The past eight years, have shown that trees or individual twigs, which had been treated with air pollutants, especially suffer from a given drought. (orig./UWA).

6747 (GSF–26/91, pp. 151-160) **Detoxification of peroxides in the needles of spruces at the research area 'Wank' in the Bavarian Alps.** Polle, A. (Fraunhofer-Inst. fuer Atmosphaerische Umweltforschung, Garmisch-Partenkirchen (Germany)); Chakrabarti, K.; Rennenberg, H. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Bayerisches Staatsministerium fuer Landesentwicklung und Umweltfragen, Muenchen (Germany). Aug 1991. (In German). (CONF-9102189–: 2. status seminar of Projektgruppe Bayern zur Erforschung der Wirkung von Umweltschadstoffen (PBWU) on forest decline, Neuherberg (Germany), 4-6 Feb 1991). In *Second status seminar of the 'Bavarian Project Group on Research into the Effect of Environmental Pollutants (PBWU)' on the major research area 'forest decline'. Proceedings.* 553p. Order Number DE93742762. Source: OSTI; NTIS (US Sales Only).

In the Alpine mountains near Garmisch-Partenkirchen more than 50% of the spruce trees are seriously injured, particularily by needle losses. At high altitude ozone is thought to cause the observed damages by oxidative stress. Components of the antioxidative defense system were investigated in spruce needles along a verticale profile (850 m to 1700 m) over 2.5 years. Superoxide dismutase activity did not increase with increasing elevation level. By contrast components of the system involved in scavenging of H_2O_2 (intracellular and apoplastic ascorbate, ascorbate peroxidase, glutathione and glutathione reductase) were higher by 30% to 40% in needles of trees grown at high altitude (1700 m) than in needles from trees grown at valley level (850 m). Glutathione and glutathione reductase did not increase continuously with increasing altitude, but were stagnaned or even reduced at medium elevation levels (1100 to 1300 m). This indicates that at medium elevation levels the vitality of spruce trees was weakened. By contrast the activity of peroxidases, in particular extracellular peroxidases, decreased with increasing altitude. (orig./UWA).

6748 (GSF–26/91, pp. 161-171) **Uptake and detoxification of chlorinated hydrocarbons by the needles of spruces.** Schroeder, P. (Fraunhofer-Inst. fuer Atmosphaerische Umweltforschung, Garmisch-Partenkirchen (Germany)). GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Bayerisches Staatsministerium fuer Landesentwicklung und Umweltfragen, Muenchen (Germany). Aug 1991. (In German). (CONF-9102189–: 2. status seminar of Projektgruppe Bayern zur Erforschung der Wirkung von Umweltschadstoffen (PBWU) on forest decline, Neuherberg (Germany), 4-6 Feb 1991). In *Second status seminar of the 'Bavarian Project Group on Research into the Effect of Environmental Pollutants (PBWU)' on the major research area 'forest decline'. Proceedings.* 553p. Order Number DE93742762. Source: OSTI; NTIS (US Sales Only).

The present study attempts to elucidate the causes of forest decline phenomena in the German calcareous Alps by investigating enzymes capable of detoxification of halogenated hydrocarbons. Enzymes responsible for this detoxification, so called Glutathione-S-Transferases (GST), have successfully been isolated from spruce needles. The enzymes show both, an annual rhythm and a distinct pattern correlated to the elevation of the stand. Highest activities are found during the summer months, lowest activities during the time of budbreak. Whereas trees with low needle loss show highest GST activities at low altitudes (850 m a.s.l.), highest GST activities in trees with high needle losses were found in the summit region of the mountain (1650 m a.s.l.). (orig.).

6749 (GSF–26/91, pp. 173-181) **Secondary metabolism of spruce and pine as an indicator for damage in different altitudes in the 'Wank' (Bavarian Alps).** Heller, W. (GSF - Forschungszentrum fuer Umwelt und Gesundheit, Neuherberg (Germany). Inst. fuer Biochemische Pflanzenpathologie); Rosemann, D.; Sandermann, H. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Bayerisches Staatsministerium fuer Landesentwicklung und Umweltfragen, Muenchen (Germany). Aug 1991. (In German). (CONF-9102189–: 2. status seminar of Projektgruppe Bayern zur Erforschung der Wirkung von Umweltschadstoffen (PBWU) on forest decline, Neuherberg (Germany), 4-6 Feb 1991). In *Second status seminar of the 'Bavarian Project Group on Research into the Effect of Environmental Pollutants (PBWU)' on the major research area 'forest decline'. Proceedings.* 553p. Order Number DE93742762. Source: OSTI; NTIS (US Sales Only).

In several experiments with air pollutants in closed chambers as well as in the Liphook (UK) outdoor experiment with spruce and pine we could demonstrate induction of the phenylpropanoid pathway in the needles of these trees. Based on these observations phenolic metabolites are expected to be suitable indicators of stress impacts in conifers. At the Wank we investigate methanol-soluble as well as cell wall-bound phenolic compounds. The cell wall is of particular interest because it is the first site of contact between a plant cell and ambient air-pollutants. Analysis of the soluble metabolites showed increasing levels of phenolic compounds such as picein, isorhapontin and kaempferol 3-glucoside with increasing altitude of the measuring area. A similar behaviour was

observed with metabolites of yet unknown structure liberated from cell walls by hydrolysis with 1 M NaOH at room temperature. One of the compounds, which was exclusively present in trees of higher altitude, was observed also in trees treated with ozone under controlled conditions. (orig.).

6750 (GSF–26/91, pp. 225-235) **Element content in spruces at various altitudes in the area of the Bavarian Alps.** Schoenborn, A. v. (Muenchen Univ. (Germany). Lehrstuhl fuer Forstpflanzenzuechtung und Immissionsforschung); Moessnang, M. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Bayerisches Staatsministerium fuer Landesentwicklung und Umweltfragen, Muenchen (Germany). Aug 1991. (In German). (CONF-9102189–: 2. status seminar of Projektgruppe Bayern zur Erforschung der Wirkung von Umweltschadstoffen (PBWU) on forest decline, Neuherberg (Germany), 4-6 Feb 1991). In *Second status seminar of the 'Bavarian Project Group on Research into the Effect of Environmental Pollutants (PBWU)' on the major research area 'forest decline'. Proceedings.* 553p. Order Number DE93742762. Source: OSTI; NTIS (US Sales Only).

Along an altitudinal gradient nutrients and pollutants were determined in current and 3 yr old needles of adult spruce trees. Excessive concentrations of pollutants are not detected. The nutritional status lies on a low level caused by the unfavourable conditions of the soils. The results of needle element analysis show a short supply in particular for nitrogen, phosphorus and iron. (orig.).

6751 (GSF–26/91, pp. 237-251) **Dynamics of water and nutrients in soils of the 'Wank' (Bavarian Alps).** Liu, J.C. (GSF - Forschungszentrum, Neuherberg (Germany). Inst. fuer Biochemische Pflanzenpathologie); Pfirrmann, T.; Payer, H.D.; Runkel, K.H.; Schramel, P. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Bayerisches Staatsministerium fuer Landesentwicklung und Umweltfragen, Muenchen (Germany). Aug 1991. (In German). (CONF-9102189–: 2. status seminar of Projektgruppe Bayern zur Erforschung der Wirkung von Umweltschadstoffen (PBWU) on forest decline, Neuherberg (Germany), 4-6 Feb 1991). In *Second status seminar of the 'Bavarian Project Group on Research into the Effect of Environmental Pollutants (PBWU)' on the major research area 'forest decline'. Proceedings.* 553p. Order Number DE93742762. Source: OSTI; NTIS (US Sales Only).

Comprehensive soil studies are carried out on 7 plots at different altitudes near Garmisch-Partenkirchen since 3 years in order to investigate the contribution of soil parameters to the spruce decline phenomena observed in the Bavarian Alps (Kalkalpen). The soils may be characterized as follows: There is no acidic stress to forest plants at this particular site. During summer, frequent events of extended drought were observed. Nutritional investigations exhibited an excellent supply with K, Ca and Mg. The N and P supply, however, must be considered insufficient. To summarize, the existing unfavourable soil conditions may act together and contribute to the decline of Norway Spruce at the Wank mountain. (orig./UWA).

6752 (GSF–26/91, pp. 253-262) **Growth and element content of fine roots of spruces on soils in the calcareous Northern Alps (Wank).** Sandhage, A. (Lehrstuhl fuer Bodenkunde und Bodengeographie, Bayreuth (Germany)); Zech, W. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Bayerisches Staatsministerium fuer Landesentwicklung und Umweltfragen, Muenchen (Germany). Aug 1991. (In German). (CONF-9102189–: 2. status seminar of Projektgruppe Bayern zur Erforschung der Wirkung von Umweltschadstoffen (PBWU) on forest decline, Neuherberg (Germany), 4-6 Feb 1991). In *Second status seminar of the 'Bavarian Project Group on Research into the Effect of Environmental Pollutants (PBWU)' on the major research area 'forest decline'. Proceedings.* 553p. Order Number DE93742762. Source: OSTI; NTIS (US Sales Only).

Since June 1990 fine-root investigations took place on the mountain Wank (Northern Calcareous Alps). The fine-roots were investigated with regard to their vitality, their distribution in soil profile, their growth dynamics, their turnover and their nutrient contents. Relationships to different soil parameters or nutrient store of the trees are to be recognized. The first results are: 1. The examined fields show a vertical gradient in their living and dead fine-roots. 2. During the vegetation period fine-root biomass has great fluctuations in the upper horizons, not so in the lower horizons. 3. Between the measured areas we couldn't see any significant differences in fine-root mass and -store. 4. The Ca- and K-nutrition of living fine-roots are good, Al concentrations are low. 5. The contents of Fe and P are not sufficient. (orig./UWA).

6753 (GSF–26/91, pp. 283-299) **Natural C- and N-isotope ratios in different compartments of damaged and healthy spruce forests.** Gebauer, G. (Bayreuth Univ. (Germany). Lehrstuhl fuer Pflanzenoekologie); Schulze, E.D. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Bayerisches Staatsministerium fuer Landesentwicklung und Umweltfragen, Muenchen (Germany). Aug 1991. (In German). (CONF-9102189–: 2. status seminar of Projektgruppe Bayern zur Erforschung der Wirkung von Umweltschadstoffen (PBWU) on forest decline, Neuherberg (Germany), 4-6 Feb 1991). In *Second status seminar of the 'Bavarian Project Group on Research into the Effect of Environmental Pollutants (PBWU)' on the major research area 'forest decline'. Proceedings.* 553p. Order Number DE93742762. Source: OSTI; NTIS (US Sales Only).

Natural carbon and nitrogen isotope ratios were measured in different compartments (needles and twigs of different ages and crown positions, litter, understorey vegetation, roots and soils of different horizons) of a healthy and a declining Norway spruce forest in the Fichtelgebirge. Further samples for the measurement of nitrogen isotope ratios were taken from healthy and declining spruce stands in Bavaria differing with respect to their parent rock material. The $\delta^{13}D$ values confirm that the carbon metabolism of the healthy and the declining stand is not different and thus is not affected by decline symptoms. The $\delta^{15}N$ values, however, are affected by decline symptoms and allow insight into important steps during the nitrogen cycle and allow the observation of nitrogen losses from declining spruce stands. (orig.).

6754 (GSF–26/91, pp. 301-310) **Dynamics of humins in polluted forest stands in the Fichtelgebirge (Germany).** Guggenberger, G. (Bayreuth Univ. (Germany). Lehrstuhl fuer Bodenkunde); Zech, W. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Bayerisches Staatsministerium fuer Landesentwicklung und Umweltfragen, Muenchen (Germany). Aug 1991. (In German). (CONF-9102189–: 2. status seminar of Projektgruppe Bayern zur Erforschung der Wirkung von Umweltschadstoffen (PBWU) on forest decline, Neuherberg (Germany), 4-6 Feb 1991). In *Second status seminar of the 'Bavarian Project Group on Research into the Effect of Environmental Pollutants (PBWU)' on the major research area 'forest decline'. Proceedings.* 553p. Order Number DE93742762. Source: OSTI; NTIS (US Sales Only).

The effects of acid deposition on concentration, fluxes and chemical composition of dissolved organic carbon (DOC) were investigated for three differently polluted forest stands in the Fichtelgebirge. Site comparison shows for all compartments except the organic layer, that increasing acid inputs go along with significantly higher DOC-concentrations and -fluxes. Qualitative differences of the DOC from the organic layer are small between the sites. In the B horizons DOC contains a higher percentage of hydrophilic acids at the more acid loaded Oberwarmensteinach soil than at the less acid loaded Wuelfersreuth soil. (orig.).

6755 (GSF–26/91, pp. 335-352) **Ion fluxes in spruce (Picea abies, [L.] Karst.) and beech tree (Fagus sylvatica, L.) ecosystems of the inner Bavarian Forest (National Park Bavarian Forest) with special regard to higher altitudes.** Heil, K. (Muenchen Univ. (Germany). Lehrstuhl fuer Bodenkunde). GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Bayerisches Staatsministerium fuer Landesentwicklung und Umweltfragen, Muenchen (Germany). Aug 1991. (In German). (CONF-9102189–: 2. status seminar of Projektgruppe Bayern zur Erforschung der Wirkung von Umweltschadstoffen (PBWU) on forest decline, Neuherberg (Germany), 4-6 Feb 1991). In *Second status seminar of the 'Bavarian Project Group on Research into the Effect of Environmental Pollutants (PBWU)' on the major research area 'forest decline'.*

Proceedings. 553p. Order Number DE93742762. Source: OSTI; NTIS (US Sales Only).

In characteristic ecosystems of Norway spruce and beech of the National Park Bavarian Forest, in altitudes of 800, 1000 and 1200 m a.s.l., we investigated the ion fluxes and the exchange capacity (CEC_e) of the soils. CEC_e show no distinct relationship to respective parent rock, soil type, elevation and stocking. Appreciable values of Mg and Ca only exist to a depth of about 5 cm. The concentrations of these ions in the soil water below the main root zones show also no dependence on the called factors. The dominating ions are Al and NO_3. Particularly at high altitudes (about 1200 m a.s.l.) the strong Al mobilisation is related to soil internal proton production by surplus nitrification. The latter process is increasing due to warm and dry weather periods. The increase in Al concentration in the soil solution may be responsible for the enhanced reduction of Mg uptake by the roots of spruce and beech. (orig.).

6756 (GSF–26/91, pp. 353-367) **Course of the decline of firs in Eastern Bavaria and in the Bavarian Alps.** Kandler, O. (Muenchen Univ. (Germany). Botanisches Inst.). GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Bayerisches Staatsministerium fuer Landesentwicklung und Umweltfragen, Muenchen (Germany). Aug 1991. (In German). (CONF-9102189–: 2. status seminar of Projektgruppe Bayern zur Erforschung der Wirkung von Umweltschadstoffen (PBWU) on forest decline, Neuherberg (Germany), 4-6 Feb 1991). In *Second status seminar of the 'Bavarian Project Group on Research into the Effect of Environmental Pollutants (PBWU)' on the major research area 'forest decline'. Proceedings.* 553p. Order Number DE93742762. Source: OSTI; NTIS (US Sales Only).

Year ring chronologies of fir trees in eastern Bavaria and the Bavarian Alps were determined. All trees showed the well-known crown symptoms typical of the so-called fir decline. They also showed abrupt decrease in incremental growth in the 1960s and 1970s, and recovery since 1981/82. This development is not correlated with changes in the concentration of air pollution or with climatic events. Both, inhibition and recovery of incremental growth started synchronously along the stem. The data are in agreement with the proposal that fir decline is an epidemic disease. By contrast, in the Bavarian Alps, no abrupt decrease in incremental growth was observed. This indicates that the collective term 'Tannensterben' has been applied to several different biotic diseases and/or damages by abiotic factors causing similar crown symptoms. (orig./UWA).

6757 (GSF–26/91, pp. 369-378) **Mineral nutrition and acute chlorosis in spruces.** Senser, M. (Muenchen Univ. (Germany). Botanisches Inst.); Hoepker, K.A. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Bayerisches Staatsministerium fuer Landesentwicklung und Umweltfragen, Muenchen (Germany). Aug 1991. (In German). (CONF-9102189–: 2. status seminar of Projektgruppe Bayern zur Erforschung der Wirkung von Umweltschadstoffen (PBWU) on forest decline, Neuherberg (Germany), 4-6 Feb 1991). In *Second status seminar of the 'Bavarian Project Group on Research into the Effect of Environmental Pollutants (PBWU)' on the major research area 'forest decline'. Proceedings.* 553p. Order Number DE93742762. Source: OSTI; NTIS (US Sales Only).

The syndrom 'acute yellowing' of spruce is experimentally inducible und reversible, as could be demonstrated by a container experiment using a forest soil of a spruce afforestation. Needle yellowing of spruce is accompanied by a K deficiency. In the yellowed needles a distinct positive correlation was found between a reduced photosynthetic capacity lower chlorophyll content and low K/N ratio of the needles. The reduction of the photosynthetic capacity as well as yellowing could be reversed by K fertilization. Thus 'acute yellowing' does not lead to an irreversible damage of essential components of the photosynthetic apparatus. This is corroborated by the fact that photosynthetic capacity based on the chlorophyll content is even higher in the yellow than in the green needles. Obviously K deficiency results in a higher sensitivity of needles against light, thus the metabolically regulated reduction of pigments operates at lower light intensities than in sun leaves. (orig./UWA).

6758 (GSF–26/91, pp. 391-412) **Biometric results of multiparameter studies with varying supply of ozone, carbon dioxide, potassium and water in young spruces in the exposure chambers of GSF.** Payer, H.D. (Inst. fuer Biochemische Pflanzenpathologie, GSF - Forschungszentrum, Neuherberg (Germany)); Pfirrmann, T.; Steiner, K.H.; Busch, U. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Bayerisches Staatsministerium fuer Landesentwicklung und Umweltfragen, Muenchen (Germany). Aug 1991. (In German). Contract EC XII/E-1 STEP EV 4V-0025. (CONF-9102189–: 2. status seminar of Projektgruppe Bayern zur Erforschung der Wirkung von Umweltschadstoffen (PBWU) on forest decline, Neuherberg (Germany), 4-6 Feb 1991). In *Second status seminar of the 'Bavarian Project Group on Research into the Effect of Environmental Pollutants (PBWU)' on the major research area 'forest decline'. Proceedings.* 553p. Order Number DE93742762. Source: OSTI; NTIS (US Sales Only).

5-year-old spruce clones subjected for some months to multifactorial treatment in exposure chambers exhibited ozone-induced inhibition of growth by 10-14 per cent. Interaction with the other factors may cause in young spruces, within one vegetation period and depending on the clone, both ozone-induced growth inhibition by up to 35 per cent if there is simultaneous deficiency of potassium and water, and ozone-induced growth enhancement by up to 60 per cent if there is inadequate water supply in combination with increased CO_2 concentration. The reproducibility of the ozone effects and small variability of data corroborate the high standing of the standardized experiments. The effect of ozone on different growth parameters (tree-top elongation, increase in stem diametre, biomass) is used to determine whether they are suited for studies of the impact of ozone. (orig./UWA).

6759 (GSF–26/91, pp. 413-423) **The influence of gaseous hydroperoxides on photosynthesis in spruce (Picea abies).** Maguhn, J. (GSF - Inst. fuer Oekologische Chemie, Attaching (Germany)); Kurth, H.H.; Gaeb, S.; Knoppik, D. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Bayerisches Staatsministerium fuer Landesentwicklung und Umweltfragen, Muenchen (Germany). Aug 1991. (In German). (CONF-9102189–: 2. status seminar of Projektgruppe Bayern zur Erforschung der Wirkung von Umweltschadstoffen (PBWU) on forest decline, Neuherberg (Germany), 4-6 Feb 1991). In *Second status seminar of the 'Bavarian Project Group on Research into the Effect of Environmental Pollutants (PBWU)' on the major research area 'forest decline'. Proceedings.* 553p. Order Number DE93742762. Source: OSTI; NTIS (US Sales Only).

After several hydrophilic organic peroxides were detected in forest air by means of a recently developed analytical method, the effect of some of these compounds on photosynthesis in spruces has been determined in laboratory experiments. Net assimilation rate and stomatal conductance of a spruce twig at natuaral CO_2 partial pressure have been observed during fumigation with hydrogen peroxide and methyl and ethyl hydroperoxides. Additional CO_2-response experiments have been carried out. The comparison of three homologous hydroperoxides should elucidate possible relationships of structure and effect. (orig./UWA).

6760 (GSF–26/91, pp. 425-437) **Sulfate accumulation in spruce needles as a consequence of SO_2 stress.** Kaiser, W.M. (Wuerzburg Univ. (Germany). Lehrstuhl Botanik 1); Dittrich, A.P.M.; Heber, U. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Bayerisches Staatsministerium fuer Landesentwicklung und Umweltfragen, Muenchen (Germany). Aug 1991. (In German). (CONF-9102189–: 2. status seminar of Projektgruppe Bayern zur Erforschung der Wirkung von Umweltschadstoffen (PBWU) on forest decline, Neuherberg (Germany), 4-6 Feb 1991). In *Second status seminar of the 'Bavarian Project Group on Research into the Effect of Environmental Pollutants (PBWU)' on the major research area 'forest decline'. Proceedings.* 553p. Order Number DE93742762. Source: OSTI; NTIS (US Sales Only).

When young spruces were fumigated for some weeks with SO_2 (100-1000 ppb), sulfate was accumulated in needles at a mean rate of 0.4 nmol x (gDW x h x ppbSO_2)$^{-1}$. This accumulation rate

agreed excellently with theoretical SO_2 fluxes into needles derived from stomatal conductances (0.37 nmol x gDW x h x $ppbSO_2$)[1]. Incorporation of S into the organic sulfur fraction was very low. Sulfate accumulation was not accompanied by cation accumulation, but by an acidification of needle homogenates. Sulfate contents of field collected spruce needles generally increased with needle age, whereas organic sulfur contents remained constant. In this case not proton but potassium contents were drastically increased. From the data, a mean annual SO_2 deposition of various regions could be calculated which came close to measured immission values. (orig./UWA).

6761 (GSF–26/91, pp. 439-451) **Effects of air pollutants on leaves.** Dittrich, A.P.M. (Wuerzburg Univ. (Germany). Inst. fuer Botanik und Pharmazeutische Biologie); Yin, Z.H.; Slovik, S.; Heber, U. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Bayerisches Staatsministerium fuer Landesentwicklung und Umweltfragen, Muenchen (Germany). Aug 1991. (In German). (CONF-9102189–: 2. status seminar of Projektgruppe Bayern zur Erforschung der Wirkung von Umweltschadstoffen (PBWU) on forest decline, Neuherberg (Germany), 4-6 Feb 1991). In *Second status seminar of the 'Bavarian Project Group on Research into the Effect of Environmental Pollutants (PBWU)' on the major research area 'forest decline'. Proceedings.* 553p. Order Number DE93742762. Source: OSTI; NTIS (US Sales Only).

The air pollutants SO_2, NO_2, and O_3 enter leaves through the stomata, and then dissolve in the apoplastic. In the mesophyll, detoxification capacities are particularly large for NO_2. Ozone requires detoxification by apoplastic reactions to avoid damage to the plasmalemma. SO_2 can be detoxified inside the cytoplasma of the cells by both reductive and oxidative reactions. The former pathway either releases hydrogen sulfide to the atmosphere or requires protein synthesis as sink for the sulfur containing amino acids eventually formed. Oxidation leads to sulfuric acid that burdens the cells with sulfate and protons. Sulfate is stored in the vacuoles. Highly effective pH-stat mechanisms are capable of neutralizing considerable acid after short term exposure to SO_2. Long term exposure requires removal of protons from the plant and uptake of cations as counterions for sulfate. Extra cation requirements caused by oxidation of SO_2 can lead to cation deficiencies of the leaves not visible in conventional cation analysis. In general, SO_2-tolerance is therefore reduced in plants growing on mineral-deficient soils. (orig./UWA).

6762 (GSF–26/91, pp. 453-462) **Contribution to the quantitative comprehension of damage to spruce stands in polluted air.** Slovik, S. (Wuerzburg Univ. (Germany). Lehrstuhl fuer Botanik 1, Inst. fuer Botanik und Pharmazeutische Biologie); Heber, U.; Koerner, C. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Bayerisches Staatsministerium fuer Landesentwicklung und Umweltfragen, Muenchen (Germany). Aug 1991. (In German). (CONF-9102189–: 2. status seminar of Projektgruppe Bayern zur Erforschung der Wirkung von Umweltschadstoffen (PBWU) on forest decline, Neuherberg (Germany), 4-6 Feb 1991). In *Second status seminar of the 'Bavarian Project Group on Research into the Effect of Environmental Pollutants (PBWU)' on the major research area 'forest decline'. Proceedings.* 553p. Order Number DE93742762. Source: OSTI; NTIS (US Sales Only).

On the basis of SO_2 immission data and meteorological data fluxes of acid and base to and from needles are calculated half-hourly since 1983 with the aid of additional information on diffusion conductances of needles, xylem sap ion concentrations and electrical phloem sap conductance. There is a considerable net uptake of acid via the stomata during winter. Limited pH-stat mechanisms (e.g. temporary deposition of acid in vacuoles) must be employed by needles. Regarding annual means of acid and base fluxes, net uptake of protons only occurs at ambient SO_2 concentrations in the air above 30 ppb. However, SO_2 influx increases the cation demand of spruce trees. Consequently, the extent of long-time SO_2 resistance depends on the cation supply by the soil and SO_2 may lead to "cation deficiency". (orig./UWA).

6763 (GSF–26/91, pp. 463-472) **Biochemical changes in the metabolism of beech trees caused by injury - the role of phytoalexines as a forest decline symptom.** Sonnenbichler, J. (Max-Planck-Inst. fuer Biochemie, Martinsried (Germany)); Zielke, H. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Bayerisches Staatsministerium fuer Landesentwicklung und Umweltfragen, Muenchen (Germany). Aug 1991. (In German). (CONF-9102189–: 2. status seminar of Projektgruppe Bayern zur Erforschung der Wirkung von Umweltschadstoffen (PBWU) on forest decline, Neuherberg (Germany), 4-6 Feb 1991). In *Second status seminar of the 'Bavarian Project Group on Research into the Effect of Environmental Pollutants (PBWU)' on the major research area 'forest decline'. Proceedings.* 553p. Order Number DE93742762. Source: OSTI; NTIS (US Sales Only).

In leaves of beech trees injured by forest decline, ozone exposition and fungal infection, 15 metabolites could be identified, the contents of which in stressed leaves differed markedly from that in the controls. The influences of leaf age and light intensity on the contents of these metabolites were examined. In leaves of trees damaged by forst decline, the contents of 7 flavonol glycosides, and 3,3', 4,4'-tetramethoxy-1,1'-biphenyl are elevated. Leaves of young beech trees treated with ozone in climate chambers showed similar alterations of the contents of these substances. In addition, some derivatives of caffeic acid strongly react to this exposition. The biphenyl seems to be a phytoalexin of beech. Possible physiological functions of the compounds are discussed. (orig./UWA).

6764 (GSF–26/91, pp. 473-481) **Comparative investigation of the pollutant uptake in needles of healthy and damaged conifers.** Schreiber, L. (Technische Univ. Muenchen (Germany). Lehrstuhl fuer Botanik); Schoenherr, J. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Bayerisches Staatsministerium fuer Landesentwicklung und Umweltfragen, Muenchen (Germany). Aug 1991. (In German). (CONF-9102189–: 2. status seminar of Projektgruppe Bayern zur Erforschung der Wirkung von Umweltschadstoffen (PBWU) on forest decline, Neuherberg (Germany), 4-6 Feb 1991). In *Second status seminar of the 'Bavarian Project Group on Research into the Effect of Environmental Pollutants (PBWU)' on the major research area 'forest decline'. Proceedings.* 553p. Order Number DE93742762. Source: OSTI; NTIS (US Sales Only).

Steady state rates of uptake in needles of conifers are proportional to the driving force, the real contact area between donor solution and cuticle and the partition coefficient cuticle/water of the substance. Using pentachlorophenol (PCP) as a model substance, it is possible to measure the rate of uptake and the contact area solution/needle in the same experiment, if the BET constant for sorption of PCP is known. To compare the permeabilities of the leaf cuticles of damaged trees with healthy trees three informations are necessary: (1) BET constants for the sorption of PCP to surfaces of healthy and damaged needles, (2) effective contact areas between solution and needle surface and (3) steady state rates of uptake. All three parameters did not differ between heavily yellowed and healthy green spruce needles. It follows, that the causes leading to yellow needle appearance do not affect chemistry and structure of surface waxes or specific permeabilities of cuticles. (orig./UWA).

6765 (GSF–26/91, pp. 483-490) **Sorption properties and permeability of cuticles for monoterpenes with special consideration of the influence of gaseous pollutants on spruce.** Schmid, C. (Technische Univ. Muenchen (Germany). Inst. fuer Botanik und Mikrobiologie); Ziegler, H. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Bayerisches Staatsministerium fuer Landesentwicklung und Umweltfragen, Muenchen (Germany). Aug 1991. (In German). (CONF-9102189–: 2. status seminar of Projektgruppe Bayern zur Erforschung der Wirkung von Umweltschadstoffen (PBWU) on forest decline, Neuherberg (Germany), 4-6 Feb 1991). In *Second status seminar of the 'Bavarian Project Group on Research into the Effect of Environmental Pollutants (PBWU)' on the major research area 'forest decline'. Proceedings.* 553p. Order Number DE93742762. Source: OSTI; NTIS (US Sales Only).

The cuticle/water partition coefficient Kc/w of isolated cuticles of Citrus, Abies and Picea for limonene, α- and β-pinene of about 10^4 was determined indicating the high accumulation of monoterpenes in the plant cuticle. Exposure of 4-year-old Norway spruce

trees to 20 and 80 ppb ozone caused a significantly higher Kc/w for limonene. For gaseous limonene and α-pinene high permeation- and diffusion coefficients were measured for astomatic cuticles of Citrus (4×10^{-11} m^2 s^{-1} and 7×10^{-15} m^2 s^{-1}). The fumigation with ecologically relevant ozone concentrations during six months did not significantly change the cuticular permeation parameters for monoterpenes. (orig./UWA).

6766 (GSF–26/91, pp. 491) **Dry deposition and uptake of air pollutants by the cuticles of plants.** Kerstiens, G. (Technische Univ. Muenchen (Germany). Lehrstuhl fuer Botanik); Federholzner, R.; Lendzian, K.J. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany); Bayerisches Staatsministerium fuer Landesentwicklung und Umweltfragen, Muenchen (Germany). Aug 1991. (In German). (CONF-9102189–: 2. status seminar of Projektgruppe Bayern zur Erforschung der Wirkung von Umweltschadstoffen (PBWU) on forest decline, Neuherberg (Germany), 4-6 Feb 1991). In *Second status seminar of the 'Bavarian Project Group on Research into the Effect of Environmental Pollutants (PBWU)' on the major research area 'forest decline'. Proceedings.* 553p. Order Number DE93742762. Source: OSTI; NTIS (US Sales Only).

Short communication. AIR POLLUTION/leaves; AIR POLLUTION/diffusion; PLANTS/pollutants; PLANTS/uptake; LEAVES; DIFFUSION; EXTRACELLULAR SPACE; PLANTS; POLLUTANTS; UPTAKE; DEPOSITION; OXYGEN; OZONE; CARBON DIOXIDE; HYDROGEN SULFIDES; SULFUR DIOXIDE; NITROGEN DIOXIDE; WATER VAPOR; SORPTION; PARTITION; MATHEMATICAL MODELS; BOILING POINTS; STOMATA

6767 (INIS-mf–14093) **Occupational cancer. A review of registered cancer cases between 1978 and 1990.** Schriftenreihe des Hauptverbandes der Gewerblichen Berufsgenossenschaften. Butz, M. Haputverband der Gewerblichen Berufsgenossenschaften e.V., St. Augustin (Germany). Nov 1991 52p. (In German). Order Number DE93744510. Source: OSTI; NTIS (US Sales Only); INIS.

In the fourth, supplementary edition work related cancer illnesses which from 1978 to 1990 were recognized by the Industrial Professional Associations as occupational diseases are described. This covers: Type of occupational disease, organs affected, causal substances, hazardous professions. In addition, for every occupational-disease, detailed data are presented, e.g. latency periods and ages at death. 16 carcinogenic substances and substance classes are considered in this catalogue including ionizing radiation. (orig./MG).

6768 (KFK-PEF–80-Vol.2, pp. 401-418) **Influence of air pollutants on bovine alveolar macrophages and on their lysosomes.** Paetzold, S. (Kernforschungszentrum Karlsruhe (Germany). Inst. fuer Genetik und Toxikologie von Spaltstoffen); Polzer, G.; Schmidt, A.; Seidel, A. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7. status colloquium of the PEF project on March 5-7, 1991 at Karlsruhe Nuclear Research Center.* 458p. Order Number DE93744819. Source: OSTI; NTIS (US Sales Only).

Bovine alveolar macrophages (RAM) were incubated with quartz particles and lysosome rich fractions were obtained by differential centrifugation from these cells. These fractions were analyzed by scanning electron microscopy and density gradient centrifugation. There were no differences between the behavior of lysosomes from quartz-treated RAM and those from untreated control cells. Thus, lysosome damage due to quartz could not be detected although the sedimentable quantity of lysosomal material is reduced and the lysosomal enzymes are leaking out of the cells. We were not able to decide by biochemical methods whether these effects are due to a primary damage localized in the lysosomal membranes or whether they are a consequence of cell death in general. After stimulation with lipopolysaccharide (LPS) RAM release a factor with properties of tumornecrosis factor ('TNF'). The same occurs after quartz phagocytosis, which by itself has no distinct effect on the capability of RAM to release 'TNF'. After 20 hours of incubation RAM react to 'Zymosan-activated' serum but not to Formyl-Methionyl-Leucyl-Phenylalanine. This migration is only slightly impaired after quartz phagocytosis. On the other hand, quartz induces the release of a factor which is a chemoattractant for other macrophages. (orig./MG).

6769 (KFK-PEF–80-Vol.2, pp. 419-428) **Metabolic changes of human lung fibroblasts after exposure to ozone.** Mayer, D. (Thoraxklinik, Heidelberg-Rohrbach (Germany)); Vogt-Moykopf, I. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7. status colloquium of the PEF project on March 5-7, 1991 at Karlsruhe Nuclear Research Center.* 458p. Order Number DE93744819. Source: OSTI; NTIS (US Sales Only).

Treatment with ozone significantly increases cellular mortality of cultivated human lung fibroblasts by 29% (1 mg/m^3 ozone for 20 hours), 74% (5 mg/m^3 ozone for 4 hours), and 107% (5 mg/m^3 ozone for 2 hours). A marked difference is observed as to the cellular sensitivity to ozone between cell lines cultivated from various patients. Synthesis of hyaluronic acid is enhanced by ozone in one fibroblast line (after 1 mg/m^3 ozone for 20 hours), and concentrations of hyaluronic acid in culture media increased in experiments using different cell lines. The latter increase is evident both in absolute terms and when referenced to protein concentrations of cell lysates and media. Cathepsin B activity was not influenced by treatment of fibroblasts with 1 mg/m^3 ozone for 20 hours. Activity of lactate dehydrogenase was reduce in one cell line (1 mg/m^3 ozone for 20 hours), and increased in another. (orig.).

6770 (KFK-PEF–80-Vol.2, pp. 429-442) **Characterization of surfactant apoproteins after damage of alveolar tissue caused by exposure with NO_x, and their pathogenetic role in toxic lung damage.** Mengel, R. (Pneumologisches Forschungslab. der Medizinischen Poliklinik, Marburg Univ. (Germany)); Mueller, B.; Bernhard, W.; Wichert, P. von. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7. status colloquium of the PEF project on March 5-7, 1991 at Karlsruhe Nuclear Research Center.* 458p. Order Number DE93744819. Source: OSTI; NTIS (US Sales Only).

Rats were exposed over a period of 72 hours in an atmosphere of 10 ppm NO_x. Analysis of the surfactant specific protein SP-A in the bronchoalveolar lavage material revealed protein cleavage products. These fragments were identical in molecular weight and immunological reaction to those obtained by in vitro cleavage reaction with elastase and cathepsin G. In two dimensional electrophoretic analysis another prominent protein spot was remarkable because this protein exhibited a shift of its pI after NO_x exposure. For analysis of the phospholipid metabolism rats were exposed to 5 ppm NO_x for 48 hours. In the model of the isolated, ventilated and perfused lung (IVPL) β-adrenergetic stimulation (10^{-5} M dopexamine + 10^{-5} M phentolamine) increased the incorporation of ^{3}H-palmitate and ^{14}C-choline into disaturated phosphatidylcholine and of ^{3}H-palmitate into phosphatidylglycerol from lung lavage of healthy rats. After exposure to nitrogendioxide the β-adrenergic stimulation was abolished. The results demonstrate, that NO_x exposure disturbs the β-adrenergic regulation of surfactant phospholipid metabolism. Further investigations will elucidate the basis of the regulational disorders. (orig.).

6771 (KFK-PEF–80-Vol.2, pp. 443-454) **In vivo and in vitro studies on carcinogenic, toxic and genotoxic activities of air pollutants (SO_2, NO_x, PAH, N-nitroso compounds, separately and in combination). Pt. 6.** Pool-Zobel, B.L. (Inst. fuer Hygiene und Toxikologie, Bundesforschungsanstalt fuer Ernaehrung, Karlsruhe (Germany)); Schmezer, P.; Zeller, W.J.; Klein, R.G. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–: 7. annual report of the Research Program for Air Pollution Prevention

Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7. status colloquium of the PEF project on March 5-7, 1991 at Karlsruhe Nuclear Research Center.* 458p. Order Number DE93744819. Source: OSTI; NTIS (US Sales Only).

This study was aimed at further elucidating mechanisms of combination effects by air pollutants and carcinogens. Part 1, In vitro investigations with fetal hamster lung cells: We tested whether exogenous ATP supply restores endonucleolytic cleavage which was shown to be inhibited by Novobiocine following Benzo(a)pyrene (BP) exposure. Part 2, In vitro/In vivo studies with adult tissues of the rat: on tumorigenesis were studied by determining the levels of carcinogen metabolizing enzymes in the rat nasal mucosa. It was found that NO_x increases glutathione-S-transferase (GST) and the additional treatment with N-nitrosodimethylamine (NDMA) elicits a synergetic response. Importantly, neither NDMA nor its combination with NO_x or SO_2 affected the levels of NDMA-demethylase (NDMA-D). Part 3, Long-term in vivo inhalation studies: The combination assay following inhalation of NDMA$\pm SO_2$ and NDMA$\pm NO_x$ has almost been completed. Here we will present the new results. (orig.).

6772 (KFK-PEF–80-Vol.2, pp. 455-464) **Effects of air pollution on spirometric parameters, bronchial hyperreactivity and risk and course of illness.** Eltschka, R. (Abt. Pneumologie, Medizinische Universitaetsklinik, Freiburg (Germany)); Herceg, R.; Moseler, M.; Matthys, H. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7. status colloquium of the PEF project on March 5-7, 1991 at Karlsruhe Nuclear Research Center.* 458p. Order Number DE93744819. Source: OSTI; NTIS (US Sales Only).

The effect of outdoor exposure to nitrogen dioxide, sulfur dioxide, ozone and particulate combustion products on extent of pulmonary function decrements and respiratory discomfort was studied over a period of 1.5 yr in the city of Freiburg. A sample of 133 non smoking adults was analysed by standardized questionaire, whole bodyplethysmography, carbachol provocation and skin prick tests. Daily peak flow (PEF) of 21 asthmatics was associated with outdoor ozone. We conclude that ambient exposures to ozone at levels below 100 $\mu g/m^3$ are associated with transient decreases in lung function. (orig.).

6773 (KFK-PEF–80-Vol.2, pp. 465-477) **Effects of air pollutants on juvenile risk groups.** Hendel-Kramer, A. (Universitaets-Kinderklinik, Freiburg (Germany)); Weiss, K.; Moseler, M.; Kuehr, J.; Forster, J.; Karmaus, W. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7. status colloquium of the PEF project on March 5-7, 1991 at Karlsruhe Nuclear Research Center.* 458p. Order Number DE93744819. Source: OSTI; NTIS (US Sales Only).

The aim of this epidemiological study was to investigate influences of indoor and outdoor air pollution on the respiratory tract of children. A population of school children, aged 7-16 years, was analysed three times in the course of three years. We analysed two different groups at risk. The first group included children with allergic sensitization (N=165), which we analysed for factors promoting symptoms of asthma. Significant noxius effects could be ascribed to the heating by stove. Frequent episodes of respiratory tract infections during early childhood also turned out to be a significant predictor. For the second population at risk (N=106) which showed specific asthma symptoms during three years the effect of air pollution on the index of Tiffeneau (FEV_1/VCIN) was estimated. Significant factors influencing the Tiffeneau were amount of NO_2-pollution as well as heating devices. In addition allergical sensitization, frequency of respiratory tract infections during early childhood, sex and age had significant influences. In conclusion our results suggest a significant susceptibility of disposed individuals to inhalable air pollutants (i.e. NO_2) on the lung ventilation in school age in a dose-dependent manner. (orig./MG).

6774 (KFK-PEF–80-Vol.2, pp. 501-511) **Effect of exposure to ozone and subsequent viral infection on airway integrity and defense mechanisms of the lung.** Freihorst, J. (Kinderklinik der Medizinischen Hochschule, Hannover (Germany). Abt. Paediatrische Pneumologie); Larbig, M.; Hardt, H. v.d.; Franke, G.; Muhle, H.; Lohmann-Matthes, M. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7. status colloquium of the PEF project on March 5-7, 1991 at Karlsruhe Nuclear Research Center.* 458p. Order Number DE93744819. Source: OSTI; NTIS (US Sales Only).

Using an animal model (BALB/c-mice) we investigate the combined effect of an exposure to ozone and subsequent respiratory infection with Respiratory Syncytial Virus (RSV). After two weeks exposure to ozone in concentrations of 0.2 ppm, 0.5 ppm, 0.8 ppm, or clean air animals were infected with RSV by intranasal instillation or were sham-infected. From day 4 to day 8 p.i. the animals received one daily dose of intranasal ovalbumin (OVA) solution. Prior to the infection and on days 7 and 21 p.i. bronchoalveolar lavage fluid (BAL) was obtained and assessed for cell numbers and differential counts; interferon and TNF production of the sampled macrophages was measured by specific cytotoxicity assays. OVA-specific antibody activity was measured in serum and BAL samples by an ELISA-assay. Ozone exposure alone did not alter cell numbers and differential counts in BAL significantly, while RSV-infected animals had clearly elevated cell numbers in BAL's taken 7 days p.i. 7 days p.i. macrophages of RSV-infected mice produced small amounts of interferon and higher amounts of TNF when compared to uninfected animals, regardless of previous ozone exposure. OVA-specific antibody activity in serum samples was highest in RSV-infected, clean air exposed animals, while ozone exposure seemed to suppress the immune response in a dose dependent manner. These preliminary data indicate that, under the given experimental setting, the effect of RSV-infection on the local cellular defense mechanisms seems to outweigh the influence of previous ozone exposure, even with concentrations as high as 0.8 ppm. The systemic immune response to inhaled antigen, however, might be influenced in an antagonistic way by these two factors. (orig./MG).

6775 (KFK-PEF–80-Vol.2, pp. 527-538) **Dust-induced stimulation of active oxygen species release in bovine alveolar macrophages.** Gercken, G. (Inst. fuer Biochemie und Lebensmittelchemie, Hamburg Univ. (Germany)); Berg, I.; Schlueter, T. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7. status colloquium of the PEF project on March 5-7, 1991 at Karlsruhe Nuclear Research Center.* 458p. Order Number DE93744819. Source: OSTI; NTIS (US Sales Only).

Bovine alveolar macrophages (BAM), obtained by post-mortem lung lavage, were exposed to different airborne dusts, waste incineration fly ash fractions and dusts from industrial production (12.5 to 1000 $\mu g/4x10^6$ cells) for 15 to 150 min. Reactive oxygen species production by BAM was evaluated fluorometrically (H_2O_2) and by SOD-inhibitable cytochrome c-reduction (O_2^-). Quartz dust Quso G 32 (Phil. Quartz Comp.) and city waste incineration ash (Ref. Mat. No 176, Comm. of the European Communities) were used as control dusts. The element content of the dusts was determined by AAS and AES/ICP. H_2O_2 and O_2^- release induced by several dusts were concentration- and time-dependent. After stimulation by quartz dust, the concentration-dependence of H_2O_2 formation was found to be parallel with the O_2^- -generating activity. In contrast, there was no parallel accumulation of O_2^- by incubation with airborne dusts and fly ash fractions although H_2O_2 production rose with increasing dust concentrations. (orig.).

6776 (KFK-PEF–80-Vol.2, pp. 545-556) **Biological effects of environmentally relevant heavy metals in combination with low doses of N-nitrosodimethylamine (NDMA) in a long-term inhalation study with SD-rats.** Klein, R.G. (Inst. fuer Toxikologie und Chemotheraphie, Deutsches Krebsforschungszentrum, Heidelberg (Germany)); Pool-Zobel, B.L.; Schmezer, P. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7. status colloquium of the PEF project on March 5-7, 1991 at Karlsruhe Nuclear Research Center.* 458p. Order Number DE93744819. Source: OSTI; NTIS (US Sales Only).

During the course of this study, inhalation experiments will be performed to assess the biological effects of heavy metal compounds alone and in combination with N-nitrosodimethylamine. Emphasis will be placed on investigating the compounds at very low doses. To achieve this aim the following experiments will be performed: (1) Kinetic studies on the deposition and retention of two heavy metal compounds following inhalation. (2) Selection of the compound which is to be further investigated in a long-term carcinogenicity bioassay, on the basis of technical feasibility as determined in (1) as well as on the basis of environmental significance and its genotoxic potential (Schmezer et al.). (3) Investigation of the carcinogenic potency of one selected heavy metal compound alone following inhalation and in combination with NDMA in long-term animal experiments. (orig.).

6777 (KFK-PEF–80-Vol.2, pp. 557-573) **Matrix structures in preneolasias and lung tumors - correlation to environmental noxes.** Fisseler-Eckhoff, A. (Inst. fuer Pathologie an den Berufsgenossenschaftlichen Krankenanstalten Bergmannsheil, Universitaetsklinik, Bochum (Germany)); Mueller, K.M. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7. status colloquium of the PEF project on March 5-7, 1991 at Karlsruhe Nuclear Research Center.* 458p. Order Number DE93744819. Source: OSTI; NTIS (US Sales Only).

Lung tumors of different histological differentiation as well as preneoplastic lesions of the bronchus will be investigated by methods of immunohistochemistry and electron microscopy due to the question of extracellular matrix differentiation in correlation to inflammatory reactions. The question of the expression of extracellular matrix components by epithelial tumor cells will be investigated by in-situ hybridisation with c-DNA probes specific for different collagen types and basement membran proteins like laminin. The role of growth factors and growth factor receptors as controllers of cellular and molecular composition, especially of extracellular matrix components will be investigated. Moreover the correlation of chromium and nickel will be analyzed by means of flameless atomic absorption spectrometry, as well as the quantification and qualification of asbestos will be determined. Aim of investigation is to get informations about early tumor invasion under consideration of environmental noxes. (orig./MG).

6778 (KFK-PEF–80-Vol.2, pp. 513-525) **Studies of tracheal mucus secretion in correlation to morphologic changes on the levels of central and peripheral airways and lung tissue in the rat after exposure to low concentrations of the air pollutants SO_2 and NO_2.** Wagner, U. (Medizinische Poliklinik, Marburg Univ. (Germany)); Amon, D.; Kimpel, C.; Saalmann, R.; Wichert, P. von; Barth, P.J. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7. status colloquium of the PEF project on March 5-7, 1991 at Karlsruhe Nuclear Research Center.* 458p. Order Number DE93744819. Source: OSTI; NTIS (US Sales Only).

To study the effects of long-term and short-term inhalation of SO_2 and NO_2 at low concentrations on tracheal mucus secretion and morphology of central, peripheral airways of male Sprague-Dawley rats were exposed to either 5 ppm SO_2 or 5 ppm NO_2 for 3 or 25 days. Mucus secretion was assessed at the rate of ^{35}S-labeled glycoprotein output. After 3 days of exposure, secretion rates decreased in NO_2-exposed rats and increased in SO_2-exposed ones. Stimulation by acetylcholine caused increases of glycoprotein output in both, SO_2- and NO_2 after 25 days of exposure. Three day exposure to 5 ppm or 10 ppm SO_2 was not seen to cause considerable changes in lung parenchyma by light microscopy. Due to 25 days exposure to 5 ppm SO_2, however, perivascular and peribronchial inflammatory infiltrations occurred. Concerning NO_2 even short-term exposure to concentrations of 5 ppm resulted in slight interstitial and alveolar edema as well as inflammatory changes in the area of the junctions of terminal bronchiole with alveolar duct. Additional morphometric studies were carried out assessing the wall thickness of bronchioli respiratorii and of alveolar septa by semiautomatic image analysis after exposure to 10 and 20 ppm NO_2 for 3 days. Both parameters significantly increased already subsequent to 10 ppm and additionally displayed significant increment subsequent to 20 ppm NO_2 due to interstitial infiltration and edema.

6779 (KFK-PEF–80-Vol.2, pp. 539-544) **Development of an assay to detect toxic and genotoxic effects in cells of the respiratory tract: Analysis of multiple parameters after exposure to heavy metals.** Schmezer, P. (Inst. fuer Toxikologie und Chemotheraphie, Deutsches Krebsforschungszentrum, Heidelberg (Germany)); Pool-Zobel, B.L.; Weber, S.; Klein, R.G. Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Apr 1991. (In German). (CONF-9103265–: 7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany), 5-7 Mar 1991). In *7. status colloquium of the PEF project on March 5-7, 1991 at Karlsruhe Nuclear Research Center.* 458p. Order Number DE93744819. Source: OSTI; NTIS (US Sales Only).

The aim of this project is to develop and employ short-term in vivo methods for the quantitative assessment of exposure to airborn genotoxic agents. For this, the following steps will be carried out: (1) Establishment of a technique to isolate primary cells from the nasal mucosa of Sprague-Dawley rats in high yield and viability. (2) Optimization of the 'Microgel Single Cell Assay' to measure DNA damage. (3) In vitro analysis of selected heavy metal compounds (Cadmium and Nickel sulfate as well as a Chromium(VI)-compound as the positive control) for induction of DNA damage. Comparison of results obtained with the methods of alkaline filter elution and microgel electrophoresis. (4) Quantitative assessment of DNA damage ex vivo in nasal mucosa cells and other target cells of Sprague-Dawley rats following short-term inhalation of heavy metal dusts or aerosols. (orig.).

6780 (NEI-DK–1014) **Experimental manipulation of a forest ecosystem: The Klosterhede-project. Project description.** Beier, C.; Rasmussen, L.; Hansen, K. (eds.). Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Oekologi og Miljoelaere. Apr 1991. 76p. Contract ENS-1323/89-1. Order Number DE93752811. Source: OSTI; NTIS.

EFP-89.

The report describes the scientific research activities at the Klosterhede research site, Lemvig, West Jutland, Denmark. The site was selected as being located on the most sensitive soil type in Denmark with respect to potential soil acidification, as a permanent observation plot. From including descriptions of the biochemical cycling and ion balances of the forest ecosystem the research has been extended to include manipulations of the water and element fluxes of the ecosystem by means of a roof construction for removal of the atmospheric inputs of strong acids to the soil. A brief overview describes the applied methods and instrumentation, the general objectives, the hypotheses to be tested and the measuring programmes in addition to a description of the site and environmental conditions. Currently, it is considered that forest decline is a multifactoral problem caused by a combined stress on the trees

from air pollution, climate, forest management, biological and abiotic influences etc. The project attempts to assess the importance of the various factors contributing to the total stress on the ecosystem. At the Klosterhede site the aim is to test some of the hypotheses by creating different research plots within the same research stand and site, thus ensuring that all soil and climatic factors are comparable whilst different manipulations of the biochemical cycles of the ecosystem are performed. The investigations, which cover nitrogen circulation, denitrification, ecophysiological activity, ectomycorrhiza and fertilization, susceptibility to insect attacks, microbial decomposition etc. are described in detail. (AB) (67 refs.).

6781 (ORNL/ER–62/R1) **Screening of contaminants in Waste Area Grouping 2 at Oak Ridge National Laboratory, Oak Ridge, Tennessee: Environmental Restoration Program.** Blaylock, B.G.; Frank, M.L.; Hoffman, F.O.; Hook, L.A.; Suter, G.W.; Watts, J.A. Oak Ridge National Lab., TN (United States). Environmental Restoration Div. Sep 1992. 272p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93000549. Source: OSTI; NTIS; GPO Dep.

Environmental Sciences Division Publication 3804.

The purpose of this report is to present the results of a health risk and ecological risk screening analysis for Waste Area Grouping 2 (WAG 2) using available data to identify contaminants and environmental pathways that will require either further investigation or immediate consideration for remediation based on the screening indices. The screening analysis will also identify contaminants that can be assigned a low priority for further investigation and those that require additional data.

6782 (SA-PUB–3/92, pp. 226-230) **Response of ombrotrophic Sphagna to N deposition and increased CO_2 levels.** Vasander, H. (Helsinki Univ. (Finland). Dept. of Forest Ecology); Jauhiainen, J. Academy of Finland, Helsinki (Finland). 1992. In *The Finnish research programme on climate change: Progress report.* 310p. Order Number DE93752870. Source: OSTI; NTIS.

SILMU Research Programme.

Ombrotrophic Sphagna growing on peatlands are adapted to relatively low level nutrient deposition from the atmosphere. During the last few decades, this amount of deposition has increased. The deposition, especially of nitrogen, may be expected to affect the growth and abundance of ombrotrophic species, such as Sphagna, particularly on raised bogs. The aim of this subproject is to study the growth response of two competing Sphagnum species receiving different nitrogen loads in the field. The two species in question are Sphagnum fuscum, which is an ombrotrophic species, and S. angustifolium, which is indifferent to trophic status. In addition, the effects of nitrogen deposition and increasing CO_2 concentrations are being studied in a laboratory experiment.

5604 Other Environmental Pollutant Effects

6783 (CONF-8907166–) **ASA conference on radiation and health: Health effects of electric and magnetic fields: Statistical support for research strategies: Final report.** American Statistical Association, Alexandria, VA (United States); Electric Power Research Inst., Palo Alto, CA (United States). May 1990. 113p. Sponsored by USDOE, Washington, DC (United States); Electric Power Research Inst., Palo Alto, CA (United States). DOE Contract FG05-89ER60779. From 8. annual American Statistical Association conference on radiation and health: health effects of electric and magnetic fields: statistical support for research strategies; Cooper Mountain, CO (United States); 9-13 Jul 1989. Order Number DE93004099. Source: OSTI; NTIS; INIS; GPO Dep.

This report is a collection of papers documenting presentations made at the VIII ASA (American Statistical Association) Conference on Radiation and Health entitled Health Effects of Electric and Magnetic Fields: Statistical Support for Research Strategies. Individual papers are abstracted and indexed for the database.

6784 (ORAU–92/F8) **Health effects of low-frequency electric and magnetic fields.** Oak Ridge Associated Universities, Inc., TN (United States). Jun 1992. 379p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-76OR00033. Order Number DE93005675. Source: OSTI; NTIS; INIS; GPO Dep.

The US Department of Labor and the President's Office of Science and Technology Policy (STP) requested that the Committee on interagency Radiation Research and Policy Coordination (CIRRPC) conduct an independent evaluation of the reported health effects from exposure to low-frequency electric and magnetic fields (ELF-EMF), especially reports of carcinogenesis and reproductive and neurophysiological effects focusing on frequencies which appeared to be of greatest public concern. Oak Ridge Associated Universities (ORAU) was tasked by the CIRRPC to oversee the review by a panel of independent, non-Federal, scientists. Following their review of over 1000 journal articles, the ORAU Panel concluded "... that there is no convincing evidence ... to support the contention that exposure to ELF-EMF generated by sources such as household appliances, video display terminals (10 to 30 KHz), and local power lines (15 to 180 Hz) are demonstrable health hazards." Although the Panel noted that some biological effects produced by these fields may be of scientific interest and warrant consideration for future research, it concluded that "... in the broad scope of research needs in basic science and health research, any health concerns over exposures to these fields should not receive a high priority."

6785 (ORAU–92/F9) **Health effects of low frequency electric and magnetic fields: Executive summary.** Oak Ridge Associated Universities, Inc., TN (United States). Jun 1992. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-76OR00033. Order Number DE93005674. Source: OSTI; NTIS; INIS; GPO Dep.

The US Department of Labor and the President's Office of Science and Technology Policy (STP) requested that the Committee on interagency Radiation Research and Policy Coordination (CIRRPC) conduct an independent evaluation of the reported health effects from exposure to low-frequency electric and magnetic fields (ELF-EMF), especially reports of carcinogenesis and reproductive and neurophysiological effects focusing on frequencies which appeared to be of greatest public concern. Oak Ridge Associated Universities (ORAU) was tasked by the CIRRPC to oversee the review by a panel of independent, non-Federal, scientists. Following their review of over 1000 journal articles, the ORAU Panel concluded "... that there is no convincing evidence ... to support the contention that exposure to ELF-EMF generated by sources such as household appliances, video display terminals (10 to 30 KHz), and local power lines (15 to 180 Hz) are demonstrable health hazards." Although the Panel noted that some biological effects produced by these fields may be of scientific interest and warrant consideration for future research, it concluded that "... in the broad scope of research needs in basic science and health research, any health concerns over exposures to these fields should not receive a high priority." This executive summary outlines the panel's investigation.

6786 (VTT-TIED–1361) **Identification of noisy vehicles.** Parmanen, J. (Technical Research Centre of Finland, Espoo (Finland). Lab. of Heating and Ventilation). Technical Research Centre of Finland, Espoo (Finland). 1992. 42p. (In Finnish). Order Number DE93752863. Source: OSTI; NTIS.

The target of the research is to study the noise caused by vehicles, the possibility of finding especially noisy vehicle groups and the factors making a vehicle especially noisy. The noise emitted by vehicles is investigated as required by the reference value for the equivalent continuous sound pressure level in the Nordic road traffic noise model. A reference noise level has been defined and measured for each vehicle. Different vehicles can be directly compared with each other on the basis of this noise level. The reference noise level is directly comparable with the emitted reference value (68 dB) for the equivalent continuous sound pressure level in the traffic noise model. The mutual relationship between the noise and speed of a vehicle in the model has also been examined, and the algorithm in this research differs from the algorithm of the model concerning the parameters. The dependence of the noise on the speed of a vehicle in the road traffic noise model turns out to be too sharp. In the model the equivalent continuous sound pressure level grows 9 dB as the speed is doubled, but according to the results of this research the growth is only about 5 dB. The gross weight of a vehicle is found to be an effecting factor in the

vehicular noise. Of the other factors examined, e.g. the age of a vehicle is not found to effect on the vehicle noise, at least not at high speeds. The light vehicles are divided into three classes according to their reference noise level, the width of the middle class being 2 dB, and the other classes consisting of the lower and the higher group levels outside the middle class.

57 HEALTH AND SAFETY

Refer also to citation(s) 5835, 5836

6787 (LBL-PUB–5341) **Chemical Hygiene and Safety Plan.** Berkner, K. Lawrence Berkeley Lab., CA (United States). Aug 1992. 286p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE93000589. Source: OSTI; NTIS; GPO Dep.

The objective of this Chemical Hygiene and Safety Plan (CHSP) is to provide specific guidance to all LBL employees and contractors who use hazardous chemicals. This Plan, when implemented, fulfills the requirements of both the Federal OSHA Laboratory Standard (29 CFR 1910.1450) for laboratory workers, and the Federal OSHA Hazard Communication Standard (29 CFR 1910.1200) for non-laboratory operations (e.g., shops). It sets forth safety procedures and describes how LBL employees are informed about the potential chemical hazards in their work areas so they can avoid harmful exposures and safeguard their health. Generally, communication of this Plan will occur through training and the Plan will serve as a the framework and reference guide for that training.

6788 (PNL–8416) **Evaluation of E and T pilot course Excavation, Trenching and Shoring taught in Chicago, Illinois, April 24, 1992.** Handwerk, E.C. Pacific Northwest Lab., Richland, WA (United States). Dec 1992. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93005604. Source: OSTI; NTIS; GPO Dep.

This report summarizes trainee evaluations for the Safety and Health Training course, Excavation, Trenching and Shoring which was conducted on April 24, 1992 at Argonne National Laboratory, in Chicago, Illinois. The first part of the report summarize the quantitative course evaluations that trainees provided upon completion of the course. Appendix A provides a transcript of the trainees' written comments.

6789 (PNL–8417) **Evaluation of construction safety in DOE course taught in Livermore, California, August 17–August 20, 1992.** Handwerk, E.C. Pacific Northwest Lab., Richland, WA (United States). Dec 1992. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93005596. Source: OSTI; NTIS; GPO Dep.

This report summarizes trainee evaluations for the Safety and Health Training Section course, "Construction Safety in DOE", which was conducted on August 17–20 for the San Francisco DOE Office, and taught in Livermore, California. Section 1.1 and 1.2 of this report summarize the quantitative course evaluations that trainees provided upon completion of the course. Appendix A provides a transcript of the trainees' written comments.

6790 (PNL–8418) **Evaluation of construction safety in DOE course taught in Kansas City, Missouri, July 7–July 10, 1992.** Handwerk, E.C. Pacific Northwest Lab., Richland, WA (United States). Dec 1992. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93005605. Source: OSTI; NTIS; GPO Dep.

This section summarizes trainee evaluations for the Safety and Health Training Section course, "Construction Safety in DOE", which was conducted July 7–10 at Allied Signal Aerospace Company,m in Kansas City, Missouri. Section 1.1 and 1.2 of this report summarize the quantitative course evaluations that trainees provided upon completion of the course. Appendix A provides a transcript of the trainees' written comments.

6791 (PNL–8420) **Evaluation of construction safety in DOE course taught in Chicago, Illinois, April 20, 1992–April 23, 1992.** Handwerk, E.C. Pacific Northwest Lab., Richland, WA (United States). Dec 1992. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE93005597. Source: OSTI; NTIS; GPO Dep.

This section summarizes trainee evaluations for the Safety and Health Training Section course, "Construction Safety in DOE", which was conducted April 20–23 at Argonne National Laboratory, in Chicago, Illinois. Section 1.1 and 1.2 of this report summarize the quantitative course evaluations that trainees provided upon completion of the course. Appendix A provides a transcript of the trainees' written comments.

6792 (VTT-TIED–1338) **Applying MORT-analysis in Finnish industry: A handbook.** Ruuhilehto, K. (Technical Research Centre of Finland, Espoo (Finland). Safety Engineering Lab.); Suokas, J. Technical Research Centre of Finland, Espoo (Finland). 1992. 73p. (In Finnish). Order Number DE93752858. Source: OSTI; NTIS.

The analysis method presented in this book is based on the MORT (Management Oversight and Risk Tree) method, originally developed at Systems Safety Center in the United States. The MORT safety analysis is intended especially for the use of organisation managements. The analysis helps managers evaluate the goals of their safety work and the measures taken to reach them, the principal goal being naturally to improve safety and thus quality as well as productivity. This version is intended for the independent use of organisations themselves. The analysis is done by team or teams, who should have expert knowledge of the organisation both vertically and horizontally in order to be able to identify the factors which may cause accidents or other interruptions in production. The identification is made by using the MORT key question set as a check list. The questions check the functions, managing of safety matters as well safety of daily as the safety planning in investment projects. A comparison is then made with an ideal model on which the question set is based. The researchers at the Safety Engineering Laboratory of the Technical Research Centre of Finland have applied the MORT method in Finnish industrial organisations for a number of years, and have consequently gathered considerable experience since the 1970's when the first steps in this field were taken. This handbook includes the question set, instructions for its use and material for internal information about the analysis in the company.

5701 Real Accidents

Refer also to citation(s) 5484, 6553

58 GEOSCIENCES

Refer also to citation(s) 4974, 4976, 4978, 5010, 6104, 6569, 6615

6793 (DOE/ER–0573P) **Summaries of FY 92 geosciences research.** USDOE Office of Energy Research, Washington, DC (United States). Engineering and Geosciences Div. Dec 1992. 165p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93004826. Source: OSTI; NTIS; GPO Dep.

The Department of Energy supports research in the geosciences in order to provide a sound foundation of fundamental knowledge in those areas of the geosciences that are germane to the Department of Energy's many missions. The Division of Engineering and Geosciences, part of the Office of Basic Energy Sciences of the Office of Energy Research, supports the Geosciences Research Program. The participants in this program include Department of Energy laboratories, academic institutions, and other governmental agencies. These activities are formalized by a contract or grant between the Department of Energy and the organization performing the work, providing funds for salaries, equipment, research materials, and overhead. The summaries in this document, prepared by the investigators, describe the scope of the individual programs. The Geosciences Research Program includes research in geophysics, geochemistry, resource evaluation, solar-terrestrial interactions and their subdivisions including Earth dynamics, properties of Earth materials, rock mechanics, underground imaging, rock-fluid interactions, continental scientific drilling, geochemical transport, solar/atmospheric physics, and modeling, with emphasis on the interdisciplinary areas. All such research is related either

directly or indirectly to the Department of Energy's long-range technological needs.

6794 (DOE/ER/14201–1) **Basement Tectonics 8: Characterization and comparison of ancient and mesozoic continental margins: Proceedings.** Bartholomew, M.J. (ed.) (South Carolina Univ., Columbia, SC (United States). Inst. of Earth Sciences and Resources); Hyndman, D.W. (ed.); Mogk, D.W. (ed.). International Basement Tectonics Association, Inc., Salt Lake City, UT (United States). [1988]. 745p. Sponsored by USDOE, Washington, DC (United States); South Carolina Univ., Columbia, SC (United States); Montana Technical Univ., MT (United States); Montana Univ., Missoula, MT (United States); Montana State Univ., Bozeman, MT (United States); Queen's Uni DOE Contract FG02-91ER14201 ;FG02-88ER13962. (CONF-8808218–: 8. international conference on basement tectonics, Butte, MT (United States), 8-12 Aug 1988). Order Number DE93003163. Source: OSTI; NTIS; GPO Dep.

The International Conference on Basement Tectonics was held in Butte, Montana, August 8–12,1988. Historically, basement tectonics conferences have focused on such topics as reactivation of faults, the influence of basement faults on metallogeny and hydrocarbon accumulation, and the use of geophysical and remote sensing techniques to interpret subsurface and surface geology. The 8th Conference diverged from past conferences in that a unifying theme was selected. Because ancient major terrane or cratonic boundaries are often postulated to be fault zones which are subsequently reactivated, the conference was organized to examine all aspects of ancient continental margins and terrane boundaries and to compare younger (Mesozoic) ones, about which more is known, with older (Paleozoic and Precambrian) ones. Moreover, because the 8th Conference was held in the northwestern United States, a greater emphasis was placed on the Mesozoic margin of western North America and the North American shield. The seven oral sessions and four poster sessions all dealt with aspects of the conference theme: characterization and comparison of ancient continental margins. The papers will be indexed individually.

6795 (LA-UR–92-2943) **3-D numerical investigation of the mantle dynamics associated with the breakup of Pangea.** Baumgardner, J.R. Los Alamos National Lab., NM (United States). [1992]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9106401–1: NATO advanced study institute on dynamics modeling and flow in the earth and planets, Fairbanks, AK (United States), Jun 1991). Order Number DE93000796. Source: OSTI; NTIS; GPO Dep.

Three-dimensional finite element calculations in spherical geometry are performed to study the response of the mantle with platelike blocks at its surface to an initial condition corresponding to subduction along the margins of Pangea. The mantle is treated as an infinite Prandtl number Boussinesq fluid inside a spherical shell with isothermal, undeformable, free-slip boundaries. Nonsubducting rigid blocks to model continental lithosphere are included in the topmost layer of the computational mesh. At the beginning of the numerical experiments these blocks represent the present continents mapped to their approximate Pangean positions. Asymmetrical downwelling at the margins of these nonsubducting blocks results in a pattern of stresses that acts to pull the supercontinent apart. The calculations suggest that the breakup of Pangea and the subsequent global pattern of seafloor spreading was driven largely by the subduction at the Pangean margins.

66 PHYSICS

6796 (INIS-mf–14105) **Max-Planck-Institute for Nuclear Physics, Heidelberg. Annual report 1991.** Klapdor-Kleingrothaus, H.V.; Kiko, J. (comps.). Max-Planck-Institut fuer Kernphysik, Heidelberg (Germany). 1992 294p. (In German). Order Number DE93750855. Source: OSTI; NTIS (US Sales Only); INIS.

The Institute's activities cover basic research work in nuclear physics and particle physics and in cosmophysics. The nuclear physics department reports experimental and theoretical investigations of the structure of atomic nuclei and hadrons, including technical developments on accelerators and storage rings and work on highly charged ions, particle detectors, ion implantations, ionometry and proton-induced X-ray spectroscopy. The cosmophysics department reports studies into the formation of the planetary system, of the comets, the interstellar medium, the cosmic radiation, the extraterrestrial matter, solar neutrions, planetary atmosphere, the chemistry of the stratosphere, and archeometry. (DG).

6610 General Physics

Refer also to citation(s) 6839

6797 (LBL–32761) **Mind, matter, and Paull.** Stapp, H.P. Lawrence Berkeley Lab., CA (United States). 10 Sep 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-9208182–1: Symposium on the foundations of modern physics 1992: the philosophic thought of Wolfgang Pauli, Helsinki (Finland), 10-12 Aug 1992). Order Number DE93002541. Source: OSTI; NTIS; INIS; GPO Dep.

The role of subjective experience in physical theory is discussed, with particular attention to the later ideas of Wolfgang Pauli. These ideas appear to open the door to a unified framework for the development of science.

6611 Classical and Quantum Mechanics

Refer also to citation(s) 6292, 7052, 7487

6798 (CONF-9204186–2) **The Coulomb three-body problem: A progress report.** Bottcher, C. (Oak Ridge National Lab., TN (United States)); Schultz, D.R. Oak Ridge National Lab., TN (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Grant PHY89-04035. From Future direction in electron-ion collision physics; Atlanta, GA (United States); 9-10 Apr 1992. Order Number DE93004532. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses the following topics on the Coulomb three-body problem: model in 2D with angular momentum; new classes of orbits; pseudoperiodic orbits - heuristic quantization; semiclassical propagator - removal of caustics; calculation of quasi-bound states; and scattering theory of resonances.

6799 (ESM–46) **Least squares orthogonal polynomial approximation in several independent variables.** Caprari, R.S. Flinders Univ. of South Australia, Adelaide (Australia). Electronic Structure of Materials Centre. Jun 1992. [29] Order Number DE93609832. Source: OSTI; NTIS (US Sales Only); INIS.

This paper begins with an exposition of a systematic technique for generating orthonormal polynomials in two independent variables by application of the Gram-Schmidt orthogonalization procedure of linear algebra. It is then demonstrated how a linear least squares approximation for experimental data or an arbitrary function can be generated from these polynomials. The least squares coefficients are computed without recourse to matrix arithmetic, which ensures both numerical stability and simplicity of implementation as a self contained numerical algorithm. The Gram-Schmidt procedure is then utilised to generate a complete set of orthogonal polynomials of fourth degree. A theory for the transformation of the polynomial representation from an arbitrary basis into the familiar sum of products form is presented, together with a specific implementation for fourth degree polynomials. Finally, the computational integrity of this algorithm is verified by reconstructing arbitrary fourth degree polynomials from their values at randomly chosen points in their domain. 13 refs., 1 tab.

6800 (IA–1471, pp. 17) **Sum Rules for the collisional radiative model.** Oreg, J. (Israel Atomic Energy Commission, Beersheba (Israel). Nuclear Research Center-Negev); Goldstein, W.H.; Bar-Shalom, A.; Klapisch, M. Israel Atomic Energy Commission, Tel Aviv (Israel). Aug 1992. In *Research laboratories annual report 1991.* [247] Order Number DE93609217. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. ENERGY-LEVEL TRANSITIONS/sum rules; ANALYTICAL SOLUTION

6801 (IFT-P–004/92) **General method for reducing the two-body Dirac equation.** Galeao, A.P.; Ferreira, P.L. Instituto de

Fisica Teorica (IFT), Sao Paulo, SP (Brazil). 1992. [26] Order Number DE93609833. Source: OSTI; NTIS (US Sales Only); INIS.

A semi relativistic two-body Dirac equation with an enlarged set of phenomenological potentials, including Breit-type terms, is investigated for the general case of unequal masses. Solutions corresponding to definite total angular momentum and parity are shown to fall into two classes, each one being obtained by solving a system of four coupled first-order radial differential equations. The reduction of each of these systems to a pair of coupled Schroedinger-type equations is also discussed. (author).

6802 (IFT-P–024/92) **Low-energy behaviour of few-particle scattering amplitudes in two dimensions.** Adhikari, S.K. (Instituto de Fisica Teorica (IFT), Sao Paulo, SP (Brazil)); Gibson, W.L. Instituto de Fisica Teorica (IFT), Sao Paulo, SP (Brazil). Jun 1992. [28] Order Number DE93609834. Source: OSTI; NTIS (US Sales Only); INIS.

A study of the analytic behavior of different few-particle scattering amplitudes at low energies in two space dimensions is presented. Such a study is of use in modeling and understanding different is presented. Such a study is of use in modeling and understanding different few-particle processes at low energies. A detailed discussion of the energy and the momentum dependence of the partial-wave on-the-energy-shell and off-the-energy-shell two-particle t matrices is given. These t matrix element tend to zero as the energy and momentum variables tend to zero. he multiple scattering series is used to show that the connected three-to-three amplitudes diverge in the low energy-momentum limit. Unitarity relations are used logarithmic singularities at the m particle breakup threshold. The sub energy singularity in the two-to-three amplitudes is also studied, and comments are made on some applications of the present study in different problems of physical interest. (author).

6803 (IFT-P–031/92) **A squeezed state holomorphic phase space representation of equations of motion.** Galetti, D.; Veiga, J.S. da. Instituto de Fisica Teorica (IFT), Sao Paulo, SP (Brazil). Aug 1992. [20] Order Number DE93609835. Source: OSTI; NTIS (US Sales Only); INIS.

A mapping scheme is presented which takes quantum operators associated to bosonic degrees of freedom into complex phase space integral kernel representatives. (author).

6804 (IFT-P–032/92) **The variational spiked oscillator.** Aguilera-Navarro, V.C. (Instituto de Fisica Teorica (IFT), Sao Paulo, SP (Brazil)); Ullah, N. Instituto de Fisica Teorica (IFT), Sao Paulo, SP (Brazil). Aug 1992. [8] Order Number DE93609836. Source: OSTI; NTIS (US Sales Only); INIS.

A variational analysis of the spiked harmonic oscillator Hamiltonian $-d^2/dx^2 + x^2 + \delta/x^{5/2}$, $\delta > 0$, is reported in this work. A trial function satisfying Dirichlet boundary conditions is suggested. The results are excellent for a large range of values of the coupling parameter. (author).

6805 (IFT-P–033/92) **Unexpected strong attraction in the presence of continuum bound state.** Delfino, A. (Universidade Federal Fluminense, Niteroi, RJ (Brazil). Inst. de Fisica); Adhikari, S.K.; Tomio, L.; Frederico, T. Instituto de Fisica Teorica (IFT), Sao Paulo, SP (Brazil). Jun 1992. [23] Order Number DE93609837. Source: OSTI; NTIS (US Sales Only); INIS.

The result of few-particle ground-state calculation employing a two-particle non-local potential supporting a continuum bound state in addition to a negative-energy bound state has occasionally revealed unexpected large attraction in producing a very strongly bound ground state. In the presence of the continuum bound state the difference of phase shift between zero and infinite energies has an extra jump of ϕ as in the presence of an additional bound state. The wave function of the continuum bound state is identical with that of a strongly bound negative-energy state, which leads us to postulate a pseudo bound state in the two-particle system in order to explain the unexpected attraction. The role of the Pauli forbidden states is expected to be similar to these pseudo states. (author).

6806 (IYaF–90-107) **A theory of quantum diffusion localization.** Chirikov, B.V. AN SSSR, Novosibirsk (Russian Federation). Inst. Yadernoj Fiziki. 1990. [12] Order Number DE93609838. Source: OSTI; NTIS (US Sales Only); INIS.

The phenomenon of quantum localization of the classical dynamic chaos is reviewed using the kicked rotator as a simple example. A new phenomenological theory of quantum dynamical relaxation is presented and compared with the existing theory and with some computer simulation data. 14 refs.

6807 (IYaF–90-109) **Patterns in chaos.** Chirikov, B.V. AN SSSR, Novosibirsk (Russian Federation). Inst. Yadernoj Fiziki. 1990. [40] Order Number DE93609839. Source: OSTI; NTIS (US Sales Only); INIS.

Classification of chaotic patterns in classical Hamiltonian systems is given as a series of levels with increasing disorder. Hamiltonian dynamics is presented, including the renormalization chaos, based upon the fairly simple resonant theory. First estimates for the critical structure and related statistical anomalies in arbitrary dimensions are discussed. 49 refs.

6808 (JINR–7-46-90, pp. 52-57) **Quantum-mechanical Hamiltonian of the nuclear-like states in the SU(2)-Skyrme model.** Nikolaev, V.A. (Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics); Tkachev, O.G. Joint Inst. for Nuclear Research, Dubna (Russian Federation). 1990. In *JINR rapid communications: Collection.* [77] Order Number DE93609511. Source: OSTI; NTIS (US Sales Only); INIS.

Quantum mechanical Hamiltonian for the nuclear-like states in the SU(2)-Skyrme model has been obtained in the framework of the collective coordinate method. The results of the calculation of the rotational bands are also presented with and without taking into account vibrational degrees of freedom. 6 refs.; 1 fig.

6809 (JINR-E–5-92-23) **A remark on the invariant measure for the nonlinear Schroedinger equation.** Zhidkov, P.E. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Theoretical Physics. 1992. [6] Order Number DE93609840. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to Differ. Equ.

The invariant measure for the nonlinear Schroedinger equation with the power nonlinearity is constructed. The proof is based on the earlier author's paper. Due to the result obtained one can apply the Poincare recurrence theorem to the nonlinear Schroedinger equation. 7 refs.

6810 (UM-P–91/26) **Proposal for an absolute, atomic definition of mass.** Wignall, J.W.G. Melbourne Univ., Parkville, VIC (Australia). School of Physics. Nov 1991. [11] Order Number DE93609842. Source: OSTI; NTIS (US Sales Only); INIS.

It is proposed that the mass of a particle be defined absolutely as its de Broglie frequency, measured as the mean de Broglie wavelength of the particle when it has a mean speed (v) and Lorentz factor γ; the masses of systems too large to have a measurable de Broglie wavelength mean are then to be derived by specifying the usual inertial and additive properties of mass. This definition avoids the use of an arbitrary macroscopic standard such as the prototype kilogram, and, if present theory is correct, does not even require the choice of a specific particle as a mass standard. Suggestions are made as to how this absolute mass can be realized and measured at the macroscopic level and, finally, some comments are made on the effect of the new definition on the form of the equations of physics. 19 refs.

6811 (UM-P–91/39) **A unified approach to classical and quantum physics.** Wignall, J.W.G. Melbourne Univ., Parkville, VIC (Australia). School of Physics. 14 May 1991. [24] Order Number DE93609843. Source: OSTI; NTIS (US Sales Only); INIS.

A non-mathematical account of a theory in which particles are pictured not as points but as spatially extended periodic disturbances in a classical background field - objects which vary in form and size according to the interactions they encounter and which, in particular, abruptly collapse to much smaller disturbances when they are detected. This quasi-classical theory treats the classical and quantum domains on the same fundamental footing. It is shown

that, when the particle sizes are small compared with their separations, they must satisfy classical laws such as Newton's equations of motion and Maxwell's electrodynamics, but when a particle is close to, or overlaps, the source of interaction its time evolution is given by quantum formulae such as the Schroedinger equation.

6812 (UM-P–91/103) **Relativistic band gaps in one-dimensional disordered systems.** Clerk, G.J.; McKellar, B.H.J. Melbourne Univ., Parkville, VIC (Australia). School of Physics. [1992]. [30] Sponsored by Australian Research Council, Canberra, ACT (Australia). (OZ-P–92/02.). Order Number DE93609841. Source: OSTI; NTIS (US Sales Only); INIS.

Conditions for the existence of band gaps in a one-dimensional disordered array of δ-function potentials possessing short range order are developed in a relativistic framework. Both Lorentz vector and scalar type potentials are treated. The relationship between the energy gaps and the transmission properties of the array are also discussed. 20 refs., 2 figs.

6813 (UM-P–92/03) **Annealed n-vector p spin model.** Taucher, T.; Frankel, N.E. Melbourne Univ., Parkville, VIC (Australia). School of Physics. [1992]. [92] Order Number DE93609844. Source: OSTI; NTIS (US Sales Only); INIS.

A disordered n-vector model with p spin interactions is introduced and studied in mean field theory for the annealed case. The complete solutions for the cases n = 2 and n = 3, is presented and explicit order parameter equations is given for all the stable solutions for arbitrary n. For all n and p was found on stable high temperature phase and one stable low temperature phase. The phase transition is of first order. For n = 2, it is continuous in the order parameters for $p \leq 4$ and has a jump discontinuity in the order parameters if $p > 4$. For n = 3, it has a jump discontinuity in the order parameters for all p. 11 refs., 4 figs.

6814 (UM-P–92/43) **Hamiltonian moments and the Lanczos method in the Heisenberg model.** Hollenberg, L.C.L.; Griffin, C.J. Melbourne Univ., Parkville, VIC (Australia). School of Physics. [1992]. [17] Sponsored by Australian Research Council, Canberra, ACT (Australia). (OZ–92/13.). Order Number DE93609845. Source: OSTI; NTIS (US Sales Only); INIS.

The connected Hamiltonian moments, $(H^n)_c$ of the one dimensional s 1/2. Heisenberg model with respect to the Neel state are calculated up to n = 17. Subsequent calculation of Hamiltonian moments, (H^n) allow the first nine iterations of the Lanczos diagonalization to be calculated analytically for arbitrarily lattice size. 12 refs., 3 figs.

6815 (UM-P–92/46) **Plaquette expansion in lattice Hamiltonian models.** Hollenberg, L.C.L. Melbourne Univ., Parkville, VIC (Australia). School of Physics. 6 Jul 1992. [16] (OZ–92/18.). Order Number DE93609846. Source: OSTI; NTIS (US Sales Only); INIS.

The Lanczos method in operator form is applied to a general lattice Hamiltonian and expressions for the first few Lanczos matrices in terms of the connected Hamiltonian moments, $(H^n)_c$, and the number of plaquettes, N_p, are obtained. Expansions in $1/N_p$ suggest a very simple general form for the first few terms in the $1/N_p$ expansions for all α_n and β_n. For the one dimensional Heisenberg spin-chain it is demonstrated that the ground-state eigenvalue of the tri-diagonal Lanczos matrix derived from this plaquette expansion approaches the true infinite lattice limit as the number of terms in the plaquette expansion is increased. 8 refs., 5 figs.

6816 (UNICAMP-IMECC-RP–24/92) **A generalization of Dirac non-linear electrodynamics, and spinning charged particles.** Rodrigues Junior, W.A.; Vaz Junior, J.; Recami, E. Universidade Estadual de Campinas, SP (Brazil). Inst. de Matematica, Estatistica e Ciencia da Computacao. Aug 1992. [20] Order Number DE93609847. Source: OSTI; NTIS (US Sales Only); INIS.

The Dirac non-linear electrodynamics is generalized by introducing two potentials (namely, the vector potential a and the pseudo-vector potential γ^5 B of the electromagnetic theory with charges and magnetic monopoles), and by imposing the pseudoscalar part of the product W W* to BE zero, with $W = A + \gamma^5 B$. Also, is demonstrated that the field equations of such a theory posses a soliton-like solution which can represent a priori a charged particle. (L.C.J.A.).

6817 (UNICAMP-IMECC-RP–29/92) **Free Maxwell equations, Dirac equation, and non-dispersive De Broglie wave packets.** Rodrigues Junior, W.A.; Vaz Junior, J.; Recami, E. Universidade Estadual de Campinas, SP (Brazil). Inst. de Matematica, Estatistica e Ciencia da Computacao. Aug 1992. [17] Order Number DE93609848. Source: OSTI; NTIS (US Sales Only); INIS.

It is shown that some elements of de Broglie's double solution theory seem to arise rather naturally from the equivalence between the free Maxwell equations and a non-linear Heisenberg-like spinor equation. Such an equivalence is proved, in the Clifford bundle formalism by making recourse to the Rainich-Misner-Wheeler theorem. (author).

6612 Techniques of General Use in Physics

Refer also to citation(s) 5219, 5220, 6300, 6342, 6438, 6446, 7138, 7139

6818 (ANL-HEP-TR–92-88) **The prospects for polarized target materials with pure carbon background.** Hill, D.A. Argonne National Lab., IL (United States). High Energy Physics Div. 6 Oct 1992. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93002987. Source: OSTI; NTIS; INIS; GPO Dep.

POLARIZED TARGETS/fabrication; FABRICATION; HYDROCARBONS; THERMODYNAMIC PROPERTIES; ALKANES; MIXTURES; CARBON 13 TARGET

6819 (ETDE/JP-mf–93753763) **Proceedings of the 1st-4th cryogenic engineering summer seminar (1988-1991).** Cryogenic Association of Japan, Tokyo (Japan). [1991] 606p. (In Japanese). Order Number DE93753763. Source: OSTI; NTIS.

This is a compilation of the papers on cryogenic engineering from 1988 to 1991 published in the seminar held by Cryogenic Association of Japan. A total of 36 papers were published and include fields of refrigeration/cooling, superconduction, cryogenic materials and cryogenic instrumentation, and a future prospect of cryogenics. Concerning refrigeration/cooling, cooling technologies are published on refrigerators, refrigeration liquefier, superconductive magnet and superfluidity helium. In the superconduction field, stated are a basis and application of superconduction, superconductive materials and cryogenic structural materials. As for instrumentation technology, a basis and applications and instrumentation technology of SQUID are explained. As an instrumentation method of superconduction characteristics, standardization is proposed for the instrumentation method for T_c and J_c. As a prospect of cryogenic engineering, it is concluded that cryogenic technology is limited to be used for the functions which are shown only at low temperature so far, but cryogenic properties which show relative superiority both in function and characteristics must be widely and steadily utilized.

6820 (ETDE/JP-mf–93753763, pp. 1-13) **Small-size freezers. 1.: Fundamentals.** Nobuki, T. (Okayama University of Science, Okayama (Japan)). Cryogenic Association of Japan, Tokyo (Japan). [1991]. 606p. (In Japanese). In *Proceedings of the 1st-4th cryogenic engineering summer seminar (1988-1991).* Order Number DE93753763. Source: OSTI; NTIS (US Sales Only).

This paper explains the fundamental aspects of a Stirling freezer, a Giford-MacMahon freeser, a modified Solvay process freezer, a virmie freezer, pulsing pipe freezing, and magnetic freezing. Classified by freezing temperature generation, freezers using the principles of isothermal reversible expansion or isothermal reversible demagnetization include Stirling cycle, virmie cycle, Carnot cycle, Ericsson cycle magnetic freezing. Those utilizing the Simon expansion include Giford-MacMahon cycle, and modified Solvay cycle freezing. The pulsing pipe freezing uses the principle of adiabatic expansion. Among these processes, the isothermal reversible expansion or isothermal reversible demagnetization system provides the highest efficiency if applied ideally. However, the other processes are free of unreasonableness and simplicity in construction covering the deficiencies in efficiency. Freezers that have been used practically among these small-size freezers are the Stirling freezer, Giford-MacMahon freezer, and the improved Solvay process freezer. 6 refs., 23 figs., 1 tab.

6821 (ETDE/JP-mf–93753763, pp. 14-28) **Small-size freezers. 2.: Applications.** Yanai, M. (Iwatani Plantec Corp., Shiga (Japan)). Cryogenic Association of Japan, Tokyo (Japan). [1991]. 606p. (In Japanese). In *Proceedings of the 1st-4th cryogenic engineering summer seminar (1988-1991).* Order Number DE93753763. Source: OSTI; NTIS (US Sales Only).

This paper introduces and evaluates practical small-size freezers, and describes the common sense in using them. The mainstream in small-size freezers consists of those using the Giford-MacMahon (G-M) cycle, the modified Solvay (M-S) cycle and the Stirling cycle. The G-M freezer is based on the Simon expansion, and the pistons are not subjected to work, that is, a work-free expansion freezer. The freezer has a large demand as a cryopump. The M-S freezer is an expansion equipment that has been developed for air liquefaction, contained in cold heat storage devices. The Stirling freezer has been developed by Kirk who used an external combustion engine inversely rotated to generate cryogenic temperatures. Cryogenic cooling systems have efficiency ten to several ten times worse than the Carnot efficiency. Therefore, the basic requirement for the cryogenic systems is to minimize heat losses in low temperatures. Cryogenic system designs require indispensably full identification of mechanical and physical properties of materials. Two-stage insulation is used normally. Special attention is called for in micro leakage of cold heat. 5 refs., 15 figs., 5 tabs.

6822 (ETDE/JP-mf–93753763, pp. 29-46) **Principle of refrigeration-liquefier.** Matsubara, Y. (Nihon University, Tokyo (Japan). Atomic Energy Research Institute). Cryogenic Association of Japan, Tokyo (Japan). [1991]. 606p. (In Japanese). In *Proceedings of the 1st-4th cryogenic engineering summer seminar (1988-1991).* Order Number DE93753763. Source: OSTI; NTIS (US Sales Only).

Mainly from the thermodynamic viewpoint, the present report explained the refrigeration-liquefier to generate the low temperature. For handling the lower refrigerating temperature than 20K by using helium gas as an operational medium, it is necessary to apply the state equation of helium or table indicating its solution and T-S diagram. In order to effectively produce the liquid helium of which the boiling point is 4.22K, it is importat for the entite system to be so balanced that the ineffective component is minimized of each element constituting the refrigeration-liquefier. The ideal refrigeration cycle can be expressed by a Carnot cycle using the concept of entropy. The refrigeration-liquefaction cycle is made up by a combination of compressor, counter current heat exchanger and Joule-Thomson valve. That cycle is called Linde cycle, too. There is a closed cycle which precools the Joule-Thomson cycle by a Brayton cycle. To heighten the COP, it is important that the excergy balance is sufficiently studied as a cycle under the given condition. 21 refs.r 14 figs.4 1 tab.

6823 (ETDE/JP-mf–93753763, pp. 47-65) **Practical operation of large refrigeration/liquefaction system.** Hosoyama, K. (National Laboratory for High Energy Physics, Tsukuba (Japan)). Cryogenic Association of Japan, Tokyo (Japan). [1991]. 606p. (In Japanese). In *Proceedings of the 1st-4th cryogenic engineering summer seminar (1988-1991).* Order Number DE93753763. Source: OSTI; NTIS (US Sales Only).

The present report introduced the structure and performance of large helium refrigeration/liquefaction system of superconducting unit which is used in the high energy accelerator and nuclear fusion reactor. As an actual example of large helium refrigeration/liquefaction system, introduced was that of Tevatron, superconducting proton synchrotron in Frmi National Acceleration Laboratory together with that of HERA, proton-electron colliding accelerator in German Electron Synchrotron Laboratory. Explanation was made of system structure and operational status of a 6.5kW helium refrigeration/liquefaction unit which is used to cool the superconducting acceleration cavity unit of TRISTAN, electron-positive electron colliding accelerator in the National Laboratory for High Energy Physics (KEK). KEK's superconducting acceleration cavity helium refrigeration system is structured of refrigeration unit's cold boxes, 12000L liquid helium dewar, circulating compressor, etc. Operation for 16000h in total has been so far made these 3 years since 1988, during which period the system was interrupted 7 times. The system was repaired from trouble within several hours after the interruption and completely recovered within 3 days after it to a state as was before the interruption. 10 refs., 20 figs., 5 tabs.

6824 (ETDE/JP-mf–93753763, pp. 66-99) **Thermal transfer at cryogenic temperature.** Ito, T. (Kyushu University, Fukuoka (Japan). Faculty of Engineering). Cryogenic Association of Japan, Tokyo (Japan). [1991]. 606p. (In Japanese). In *Proceedings of the 1st-4th cryogenic engineering summer seminar (1988-1991).* Order Number DE93753763. Source: OSTI; NTIS (US Sales Only).

By giving exercises for the study, the present report generally explained the thermal transfer in the temperature range in which the highest temperature was more or less 112K, equal to the boiling point of methane (main content of LNG) under the atmospheric pressure. In the thermal transfer at cryogenic temperature, application has only to be made of thermal properties at low temperature to the analytical calculation of arrangement formulae in the above type of thermal transfer. However in its other type where, as is the case with the termal transfer by boiling and that of supercritical pressure fluid, the mechanism of thermal transfer is not exactly elucidated, experimentation must establish the thermal transfer characteristics. If an inconvenience or contradiction is found in the general analysis method and arrangement formulae from the experimental result of thermal transfer type where the analysis method and arrangement formulae are judged to be established with a good comprehension of thermal transfer mechanism, it means that an essential defect will be pointed out in the conventional analysis method and arrangement formulae. Therefore, it is always important to prudently evaluate the result of experiment which was carefully conducted. 55 refs., 10 figs., 2 tabs.

6825 (ETDE/JP-mf–93753763, pp. 100-125) **Principle of superfluid helium cooling.** Kamioka, Y. (Toyo Sanso K.K., Tokyo (Japan)). Cryogenic Association of Japan, Tokyo (Japan). [1991]. 606p. (In Japanese). In *Proceedings of the 1st-4th cryogenic engineering summer seminar (1988-1991).* Order Number DE93753763. Source: OSTI; NTIS (US Sales Only).

The present report explained the thermal transfer in superfluid helium. The thermal diffusion or transfer in superfluid helium is very quick, which is the prime cause of its being utilized. Pressurized superfluid helium (overcooled fluid helium) if further used becomes a very strong refrigerant, because power is added by the superfluid helium proper as thermal absorbent. The thermal transfer in superfluid helium is explained by the thermal conduction expressed by the thermal Kapitza boundary resistance and Gorter-Mellink formula. However in case that HeI and vapor coexist, what simultaneously appears with the above thermal transfer is the thermal transfer mechanism, i.e., conduction, boiling and convection which form a normal phenomenon of thermal transfer. In such a case, it is necessary to analyze the above thermal transfer mechanism and elucidate the entire thermal transfer. The low temperature system using the superfluid helium is used in the nuclear fusion tester, artificial satellite-mounted far infrared telescope, high energy particle accelerator, superhigh magnetic field generator, etc. 37 refs., 29 figs., 2 tabs.

6826 (ETDE/JP-mf–93753763, pp. 126-140) **Design of cryostat.** Omori, T. (Ishikawajima-Harima Heavy Industries, Co. Ltd., Tokyo (Japan)). Cryogenic Association of Japan, Tokyo (Japan). [1991]. 606p. (In Japanese). In *Proceedings of the 1st-4th cryogenic engineering summer seminar (1988-1991).* Order Number DE93753763. Source: OSTI; NTIS (US Sales Only).

The high energy particle accelerator use superconducting electromagnet being selected as an actual example, the present report explained the thermal insulation system and superconducting coil support structure of cryostat. Being a vessel to contain the superconducting coil, the cryosat must be studied in thermal insulation performance and structural strength with a special importance for its design, because cryogenic helium is needed to cool the coil against the generation of extremly strong magnetic field. The thermal insulation performance can be maintained by so-called vacuum multilayer insulator which is materially so extremely low in thermal conductivity as to able to control the boiling rate of helium or load on refrigerator. Therefore designwise, the conductive thermal transfer is dominant through the coil support structure. From the point of electromagnetic force support, the coil support structure must be

high in rigidity, which however becomes a reverse effect on the other point of thermal invasion control. Therefore in order to satisfy both the requirements opposed to each other and build up an almost thermal invasion-free support structure, it is necessary to utilize composite maerials and study the thermal anchoring method. 12 refs., 15 figs., 5 tabs.

6827 (ETDE/JP-mf–93753763, pp. 141-154) **Cooling in superconducting magnet. (I).: Principle (magnet stabilization by cooling).** Tsukamoto, O. (Yokohama National University, Yokohama (Japan)). Cryogenic Association of Japan, Tokyo (Japan). [1991]. 606p. (In Japanese). In *Proceedings of the 1st-4th cryogenic engineering summer seminar (1988-1991).* Order Number DE93753763. Source: OSTI; NTIS (US Sales Only).

The present report explained the cooling method to stabilize the superconducting magnet operation. It is impossible to completely eliminate the disturbance which affects the wire of superconducting magnet. Therefore, it is necessary to cool the energy of disturbance by a refrigerant not to germinate a normal conduction in the wire or take measures to extinguish the normal conduction part, if primarily generated, when the disturbance ceases to exist. Concretely, the cooling for the stabilization is made by using compositely structured wire which is superconducting element wire wrapped up in copper, aluminum or other superconductive metal as stabilizing material. In case of partial transition of wire to the normal conduction, its being compositely structured quantitatively controls the Joule heat by by-passing the current through the stabilizing material, which can further effectuate the cooling by increasing the effective area of wire. For the rational design of electromagnet, it is necessary to heighten the current density of magnet coil by quantitatively decreasing the copper as much as possible with maintaining the reliable stability of magnet. 18 figs.

6828 (ETDE/JP-mf–93753763, pp. 155-167) **Cooling in superconducting magnet. (II).: Actual operation.** Ogata, H. (Hitachi, Ltd., Tokyo (Japan)). Cryogenic Association of Japan, Tokyo (Japan). [1991]. 606p. (In Japanese). In *Proceedings of the 1st-4th cryogenic engineering summer seminar (1988-1991).* Order Number DE93753763. Source: OSTI; NTIS (US Sales Only).

The present report explained the actual operation of cooling to maintain the operational temperature as specified of superconducting magnet. The cooling method of superconducting magnet is classified by the fluid morphology of refrigerant into natural fluidity and enforced fluidity. The thermal transfer is morphologically classified into pool boiling, natural convection, enforced convection, thermal conduction and superfluidization. What is the most widely used is a cooling method by natural fluidity which transfers the heat by the boiling of liquid helium. The boiling is high in thermal transfer coefficient and can be completely stabilized in it. As the conductor is integrated with the passage of cooling flow, the cooling by enforced fluidity can use a conductor sufficiently wrapped up in electrical insulation cover and moreover, maintain the mechanical strength. As a refrigerant, gaseous and liquid two-phase flow of saturated helium and supercritical helium are used and can resist a considerably strong disturbance. At present, the cooling of superconducting magnet is judged not established yet in cooling method. It is most important to accurately evaluate various disturbances. 11 refs., 16 figs.

6829 (ETDE/JP-mf–93753763, pp. 422-440) **Cryogenic structural materials.** Nishijima, S. (Osaka University, Osaka (Japan). The Institute of Scientific and Industrial Research). Cryogenic Association of Japan, Tokyo (Japan). [1991]. 606p. (In Japanese). In *Proceedings of the 1st-4th cryogenic engineering summer seminar (1988-1991).* Order Number DE93753763. Source: OSTI; NTIS (US Sales Only).

In connection with putting the superconducting magnet to practical use, the present report explained the cryogenic structural materials. The metallic material design prevents either the plastic deformation by making the load affecting the structural member to be lower than the elastic limit or dynamic fracture by making the loaded load to be lower than the critical load. In other words, the raised points of problem are the yield stress and ultimate strength. Heightening with lowering in temperature, both those physical values are teleologically good. However if there is mechanical defect in the material, the brittle fracture is eased with lowering in temperature. Therefore, the low temperature brittleness must be hardly shown, which necessitates the materials to be plastically deformed and yield even at cryogenic temperature at the extremity of crack. However, it is finally important that the plastic deformation power balances with a high yield stress. The low temperature brittleness is not shown by the austenitic stainless steel of face-centered cubic structure, which is however improved by a solid solution reinforcement as the yield stress is low. Organic combined materials are mainly used for the thermal insulation support members. Particularly, glass fiber reinforced organic combined materials are advantageously used at low temperature because of their breaking stress, breaking dislocation and absorbed energy of Charpy impact test which increase with lowing in temperature. 14 figs.

6830 (INIS-mf–14104) **Development of a plasma system as a source of radiation for X-ray microscopy.** Neff, W.; Lebert, R.; Holz, R. Fraunhofer-Institut fuer Lasertechnik (ILT), Aachen (Germany); Bundesministerium fuer Forschung und Technologie, Bonn (Germany). [1992] 112p. (In German). Contract BMFT 13N5329A. Order Number DE93750346. Source: OSTI; NTIS (US Sales Only); INIS.

During the period of the report, an X-ray source was developed for a laboratory X-ray microscope based on a plasma focus. Nitrogen is used as the discharge gas. The Lyman α line (λ = 2.48 nm) of nitrogen ions N VII similar to hydrogen is used for the image in the microscope. This line is favourably situated at the start of the water window (2.33 - 4.37 nm), so that the microscope is particularly suitable for the examination of biological objects. (orig.).

6831 (LA-UR–92-3853) **Superfluid Stirling refrigerator with a counterflow regenerator.** Brisson, J.G.; Swift, G.W. Los Alamos National Lab., NM (United States). [1992]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-921130–1: 7. international cryocooler conference, Santa Fe, NM (United States), 15-19 Nov 1992). Order Number DE93003858. Source: OSTI; NTIS; GPO Dep.

The superfluid Stirling refrigerator (SSR) uses a ^{3}He-^{4}He liquid mixture as a working fluid. It operates at temperatures below 2 K where the ^{4}He component of the working fluid is superfluid. The ^{3}He component of the working fluid, to first approximation, behaves thermodynamically like an ideal gas in the inert background of superfluid ^{4}He. Using pistons equipped with a superleak bypass, it is possible to expand and compress the ^{3}He solute "gas." The SSR is a Stirling machine equipped with these "superleaked" pistons to take advantage of the properties of the ^{3}He solute to cool below 1 K. The proof of principle was shown by Kotsubo and Swift in 1990. There are three other techniques for cooling below 1 K: (1) the ^{3}He-^{4}He dilution refrigerator which utilizes the endothermic heat of mixing of ^{3}He into ^{4}He to reach temperatures below 0.010 K; (2) the evaporation of ^{3}He which can reach temperatures of 0.3 K; and, (3) adiabatic demagnetization of a paramagnetic salt. There are several advantages of the SSR over each of the other techniques. The power consumption of a dilution refrigerator is typically on the order of kilowatts; whereas, the SSR consumes hundreds of watts. The SSR has the potential to cool below 0.3 K and out-perform the evaporative ^{3}He refrigerator. Adiabatic demagnetization often requires magnetic shielding between the refrigerator and the object to be cooled; obviously, the SSR requires no such shielding. There is an interest in developing subkelvin cryocoolers for satellite-borne X-ray and infrared detectors. In space applications, the power consumption of an SSR can be reduced to tens of watts. This coupled with the SSR's insensitivity to a zero G environment makes it an attractive option to cool detectors in space.

6832 (UCRL–53943-91, pp. 173-175) **4-MV ion-accelerator system for materials studies.** Musket, R.G. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

With the addition of a 4-MV ion-accelerator system, the author has enhanced the laboratory's capabilities for characterizing and modifying materials. This system generates MeV ions that can be used to perform quantitative, nondestructive analysis of materials by four ion-beam techniques: ion backscattering, particle-induced

x-ray emission, ion-induced nuclear-reaction analysis, and forward-recoil spectroscopy. In addition, materials can be modified by using high-energy ion implantation and irradiation.

6613 Other Aspects of Physical Science

Refer also to citation(s) 5431, 5664, 6383, 6878, 6940, 6961, 7246

6833 (BNL–48171) **The GALLEX solar neutrino experiment.** Hahn, R.L. Brookhaven National Lab., Upton, NY (United States). [1992]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-921122–5: Meeting of the Division of Particles and Fields of the American Physics Society, Batavia, IL (United States), 10-14 Nov 1992). Order Number DE93003357. Source: OSTI; NTIS; INIS; GPO Dep.

The recently published GALLEX result, 83 ± 19 (stat.) ±8 (syst.) SNU (10σ), was obtained from data accumulated from 14 solar runs (with counting done to May, 1992). This value, while 2 standard deviations below the predictions of solar models, provided the first direct evidence for solar pp neutrinos. The signature for neutrino capture in the aqueous gallium-chloride detector was the observation of the characteristic energy spectrum (K and L X rays/Auger electrons), decaying with the half-life of the chemically isolated radioactive product, ^{71}Ge. By adding to the data set 1 more solar run plus 4 additional months of counting (to September, 1992), an updated value of the GALLEX production rate was obtained, which, interestingly, does not differ perceptibly from our published value.

6834 (CONF-9010289–5) **Observations of TeV photons at the Whipple Observatory.** Lamb, R.C. (Iowa State Univ. of Science and Technology, Ames, IA (United States)); Lewis, D.A.; Macomb, D.J.; Vacanti, G.; Akerlof, C.W.; Meyer, D.I.; Cawley, M.F.; Colombo, E.; Kwok, P.W.; Lang, M.J.; Reynolds, P.T.; Weekes, T.C.; Fegan, D.J.; O'Flaherty,Iowa State Univ. of Science and Technology, Ames, IA (United States). [1990]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-80ER10774. From International conference on high energy gamma ray astronomy; Ann Arbor, MI (United States); 2-5 Oct 1990. Order Number DE93003720. Source: OSTI; NTIS; GPO Dep.

The Whipple Observatory 10 m gamma-ray telescope has been used to search for TeV gamma-ray emission from a number of objects. This paper reports observations of six galactic and three extragalactic objectsusing the Cherenkov image technique. With the introduction of a high-resolution camera (1/4° pixel) in 1988, the Crab Nebula was detected at a significance level of 20 ω, in 30 hours of on-source observation. Upper limits at a fraction of the Crab flux are set for most of the other objects, based on the absence of any significant dc excess or periodic effect when an a priori Monte Carlo determined imaging selection criterion (the "azwidth cut") is employed. There are weak indications that one source, Hercules X-1, may be an episodic emitter. The Whipple detection system will be improved shortly with the addition of a second reflector 11 m in diameter (GRANITE) for stereoscopic viewing of showers. The combination of the two-reflector system should have a signal-to-noise advantage of 10^3 over a simple non-imaging Cherenkov receiver.

6835 (DOE/ET–53088-577) **Magnetic reconnection and current-sheet formation at x-type neutral points.** Steinolfson, R.S. (Southwest Research Inst., San Antonio, TX (United States). Dept. of Space Sciences); Ofman, L.; Morrison, P.J. Texas Univ., Austin, TX (United States). Oct 1992. 26p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract FG05-80ET53088. Contract ATM-90-15705. (IFSR–577). Order Number DE93002161. Source: OSTI; NTIS; INIS; GPO Dep.

Numerical solutions of the nonlinear, resistive magnetohydrodynamic (MHD) equations are used to study the evolution of a perturbed or stressed x-type neutral point. By performing individual simulations for both compressible and incompressible plasmas, we are able to demonstrate that the important physics for this problem involves just the interaction between the plasma flow velocity and the magnetic field and that the thermodynamics has a relatively passive effect. We have also done separate simulations for both solid, conducting wall boundary conditions at a fixed distance from the x-point and for open boundary conditions that adjust as required by the evolving solution within the boundaries. With solid, conducting wall boundary conditions, our solutions for azimuthally symmetric disturbances agree with those obtained in previous analytic linear studies. In this case the stressed x-point relaxes back to the unstressed state on a time scale somewhat shorter than the time scale for the linear resistive tearing mode. Perturbations that are not azimuthally symmetric can relax even faster than the symmetric modes. When the conditions at the boundary are free to adjust, the disturbances grow in amplitude on an Alfven time scale with the eventual formation of a current sheet separating two y-points. This rapid growing behavior is, of course, in sharp contrast to the relatively slow decaying solutions obtained with closed boundaries. The growing solutions qualitatively agree with previous analytic x-point solutions that have been suggested as an explanation for the rapid energy conversion in flares and substorms.

6836 (IA–1469) **Evanescent field infrared spectroscopy using chalcogenide glass fiber.** Katz Moti (Israel Atomic Energy Commission, Yavne (Israel). Soreq Nuclear Research Center). Tel Aviv Univ. (Israel). Jun 1992. [132] (In Hebrew). Order Number DE93609872. Source: OSTI; NTIS (US Sales Only); INIS.

In the last few years a simple and cheap fiber-optics based spectroscopy method was developed for the investigation of liquids, pastes gases and thin layers. The fiber is immersed in the sample, and the investigated material becomes the fiber cladding. the interaction between the guided radiation in the fiber and the specimen is taking place by evanescent field which extends outside the fiber. This work concentrates in the quantitative characterization of the absorption of the evanescent field by the fiber cladding (the specimen). This subject was dealt with only briefly in the earlier works, and the aim of this work is to obtain a comprehensive understanding of this issue. (author).

6837 (INPE–5359) **Construction of a 13 kG magnetic coil system.** Rossi, J.O.; Aso, Y.; Castro, P.J.; Barroso, J.J.; Ludwig, G.O.; Montes, A.; Nono, M.C.A.; Correa, R.A. Instituto de Pesquisas Espaciais (INPE), Sao Jose dos Campos, SP (Brazil). Aug 1991. [43] (In Portuguese). (PRP–163.). Order Number DE93609873. Source: OSTI; NTIS (US Sales Only); INIS.

The construction of magnetic coil system for a 35 GHz gyrotron is reported in great detail. This system is designed to generate a magnetic induction of 13,2 kG over an extension of 13 cm. By using an operating current of about 100 A, it was verified that both the axial magnetic field profile and the spatial non-uniformity are in close agreement with those theoretically predicted. (author).

6838 (JAERI-M–92-080) **A molecular dynamics simulation code ISIS.** Kambayashi, Shaw (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment). Japan Atomic Energy Research Inst., Tokyo (Japan). Jun 1992. 51p. (In Japanese). Order Number DE93753187. Source: OSTI; NTIS; INIS.

Computer simulation based on the molecular dynamics (MD) method has become an important tool complementary to experiments and theoretical calculations in a wide range of scientific fields such as physics, chemistry, biology, and so on. In the MD method, the Newtonian equations-of-motion of classical particles are integrated numerically to reproduce a phase-space trajectory of the system. In the 1980's, several new techniques have been developed for simulation at constant-temperature and/or constant-pressure in convenient to compare result of computer simulation with experimental results. We first summarize the MD method for both microcanonical and canonical simulations. Then, we present and overview of a newly developed ISIS (Isokinetic Simulation of Soft-spheres) code and its performance on various computers including vector processors. The ISIS code has a capability to make a MD simulation under constant-temperature condition by using the isokinetic constraint method. The equations-of-motion is integrated by a very accurate fifth-order finite differential algorithm. The bookkeeping method is also utilized to reduce the computational time. Furthermore, the ISIS code is well adopted for vector processing: Speedup ratio ranged from 16 to 24 times is obtained on a VP2600/10 vector processor. (author).

6839 (LA–12377-MS) **Bibliography Group T-3, 1955–1991.** Findley, M. Los Alamos National Lab., NM (United States).

Sep 1992. 43p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93002851. Source: OSTI; NTIS; GPO Dep.

This bibliography includes all known unclassified publications by members of Group T-3 between 1955 and 1991. They principally describe or show extensive use of numerical computing methods for hydrodynamics problems developed by members of Group T-3. In particular, the listing refers to papers on the following topics: high-speed fluid dynamics, low-speed dynamics, all-speed dynamics, magnetodynamics and plasma physics, turbulence, reactive flows and sprays, dynamic response of materials, and general physics and mathematics.

6840 (LA–12427-T) **A search for 100 TeV gamma-ray emission from the x-ray binary pulsar 4U 0115+63 using the CYGNUS extensive air-shower array.** Alexandreas, D.E. Los Alamos National Lab., NM (United States). Nov 1992. 67p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93004129. Source: OSTI; NTIS; GPO Dep.

Thesis submitted to University of California, Irvine.

A search has been performed for unpulsed and pulsed Ultra-High-Energy gamma-ray emission from the X-ray transient binary pulsar 4U 0115+63 over timescales ranging from one source-day to the entire data set. The motivation has been the detection at TeV energies of 4U 0115+63 by the Cerenkov telescope at Dugway, operated by the University Durham. The search has been performed in the database of the CYGNUS I extensive air-shower array that extends from April 1986 to March 1992, and contains 17,000 hours of data from the source direction. In the search for unpulsed emission, the background is estimated by creating random events from the actually detected data-set, and the Li & Ma statistic is used to evaluate the statistical significance of a background fluctuation. The Rayleigh test and its power are employed in the search for pulsed emission. No statistically significant evidence for emission can be found. No correlation with its 24-day orbital period can be seen. A 90% confidence-level upper limit on the unpulsed continuous flux from 4U 0115+63 above 130 TeV is 7.0×10^{-15} cm^{-2} s^{-1}. This value agrees with that of the Whipple collaboration but is at least one order of magnitude lower than other upper limits or claimed detections.

6841 (LA-UR–92-3315) **Proxy and in-situ studies of dayside magnetopause reconnection.** Scurry, L. (California Univ., Los Angeles, CA (United States). Inst. of Geophysics and Planetary Physics); Russell, C.T.; Gosling, J.T. Los Alamos National Lab., NM (United States); California Univ., Los Angeles, CA (United States). Inst. of Geophysics and Planetary Physics. [1992]. 12p. Sponsored by Department of Defense, Washington, DC (United States); National Aeronautics and Space Administration, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9205201–2: Solar-terrestrial predictions workshop, Ottawa (Canada), 18-22 May 1992). Order Number DE93003740. Source: OSTI; NTIS; GPO Dep.

The functional dependence of magnetic reconnection on solar wind parameters is examined utilizing the am geomagnetic index and satellite observations at the magnetopause. Several parameters in the solar wind are found to control geomagnetic activity. Reconnection is found to be most efficient when the interplanetary magnetic field is southward, although some activity remains when the IMF is horizontal and slightly northward. The reconnection efficiency increases with the solar wind dynamic pressure but decreases when the Mach number is greater than 7.5. These results are compared with the functional dependencies found by correlating solar wind and magnetosheath measurements with observations of accelerated tows at the magnetopause. Accelerated tows are found to occur most often when the interplanetary magnetic field is directed southward. However, accelerated flows do occur when the IMF is horizontal and northward. Accelerated flows are also affected by the magnetosheath beta such that higher beta inhibits their occurrence. The location of accelerated tows indicates that reconnection occurs mainly at the subsolar point.

6842 (LA-UR–92-3336) **Theory of coronal streamer formation.** Kopp, R.A. Los Alamos National Lab., NM (United States). [1992]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9208187–1: Solar and Heliospheric Observatory (SOHO) workshop, Annapolis, MD (United States), 25-28 Aug 1992). Order Number DE93003736. Source: OSTI; NTIS; GPO Dep.

Conceptually, coronal streamers can form (and disappear) by either of two distinct processes: plasma "filling" and outward distention of a preexisting closed magnetic structure; and magnetic reconnection, for whatever reason, of an open bipolar field configuration. We argue that the majority of stable-appearing streamers on the Sun at any time are in fact of the latter category - namely, open-field structures undergoing gradual reconnection. Quasi-steady (i.e., "convectively relaxed") reconnection models may be required to explain the narrow high-density cores exhibited by most streamers out to distances of many solar radii. We discuss some of the observational signatures of reconnection within streamers, which the instrumentation aboard SOHO may be capable of detecting.

6843 (LA-UR–92-3647) **Near-earth orbject interception workshop summary.** Canavan, G.H.; Solem, J. Los Alamos National Lab., NM (United States). 27 Oct 1992. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9210237–1: Near earth objects (NEO) workshop, Los Alamos, NM (United States), Oct 1992). Order Number DE93003793. Source: OSTI; NTIS; GPO Dep.

A workshop at Los Alamos in January 1992 evaluated the issues involved in intercepting celestial objects approaching the Earth. It covered the technologies for acquiring, tracking, and homing on them, as well as those for interceptors to inspect, rendezvous with, land on, irradiate, deflect, or destroy them. This report records the presentation and technical options reviewed.

6844 (LA-UR–92-3789) **Lunar and asteroid composition assessment using remote secondary ion mass spectrometry.** Funsten, H.O.; Elphic, R.C.; Barraclough, B.L.; McComas, D.J.; Moore, K.R.; Nordholt, J.E. Los Alamos National Lab., NM (United States). [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9211130–2: International symposium on spectral sensing research, Maui, HI (United States), 15-20 Nov 1992). Order Number DE93003839. Source: OSTI; NTIS; GPO Dep.

Compositional analysis of the Moon and asteroids is of scientific importance as a window into the formation and evolution of the solar system. Additionally, global geochemical surveys can be utilized to examine available resources for further exploration of the solar system. We present a quantitative analysis of a technique of elemental composition of planetary surfaces using remote secondary ion mass spectrometry (SIMS). Remote SIMS, in principle identical to laboratory SIMS, utilizes solar wind ions to sputter secondary ions from a planetary surface. The trajectories of these secondary ions are governed by local electric and magnetic fields. An ion mass spectrometer located on an orbiting platform detects these ions and evaluates their mass and velocity. The origin at the planetary surface of a detected ion is determined by its velocity at the orbiter and knowledge of the solar wind electric and magnetic fields. The elemental composition of the planetary surface is determined by comparison of the detected amounts of various elements.

6845 (LA-UR–92-3819) **Numerical models of planetary dynamos.** Glatzmaier, G.A. (Los Alamos National Lab., NM (United States)); Roberts, P.H. Los Alamos National Lab., NM (United States). [1992]. 24p. Sponsored by National Aeronautics and Space Administration, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9207166–1: 1992 Studies of the earth's deep interior (SEDI) symposium, Mizusawa (Japan), 5-10 Jul 1992). Order Number DE93003848. Source: OSTI; NTIS; INIS; GPO Dep.

We describe a nonlinear, axisymmetric, spherical-shell model of planetary dynamos. This intermediate-type dynamo model requires a prescribed helicity field (the alpha effect) and a prescribed buoyancy force or thermal wind (the omega effect) and solves for the axisymmetric time-dependent magnetic and velocity fields. Three very different time dependent solutions are obtained from different prescribed sets of alpha and omega fields.

6846 (LA-UR–92-3845) **Report of the working group on magnetotail/plasma sheet structure.** Birn, J. (Los Alamos National Lab., NM (United States)); Fairfield, D. Los Alamos National Lab., NM (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9207168–1: Geospace environment modeling workshop on magnetotail/substorms, Snowmass, CO (United States), 2-3 Jul 1992). Order Number DE93003857. Source: OSTI; NTIS; GPO Dep.

The magnetotail and its imbedded plasma sheet represent the major region where excess energy is stored in the magnetosphere. It is consequently the principal site where energy release starts and magnetospheric activity is initiated. The qualitative understanding and quantitative description of its average and instantaneous structure and its dependence on solar wind and ionospheric boundary conditions are therefore at the core of magnetospheric physics and modeling. In this report we concentrate on the assessment of present knowledge and open questions concerning the average tail and its instantaneous structure during steady periods or for changes that are slow in comparison to the fast dynamic scale of magnetospheric substorms. Quantitatively, one might draw a destinction at about 1 minute, which is slightly larger than a typical magnetosonic (or Alfven) wave propagation time over a characteristic macroscopic scale of a few Earth radii. This restriction not only excludes the fast dynamic evolution after substorm (expansive phase) onset but also time-dependent phenomena such as waves, eigenmodes, etc. that are not necessarily related to substorm activity. We also exclude questions of stability. The major goal within this area consists of the construction and improvement of quantitative models, empirical and selfconsistent, at various levels of sophistication as required by particular applications. Such models not only represent the quantification of observations and physical understanding of the magnetospheric structure but also are needed as the basis for a variety of further investigations, such as test particle studies, stability analyses, and MHD simulations.

6847 (SAND–91-2396C) **Application of boundary element techniques to the motion of aerosol particles.** Mondy, L.A.; Geller, A.S.; Rader, D.J. Sandia National Labs., Albuquerque, NM (United States). [1991]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-920664–3: 7. international conference on boundary element technology, Albuquerque, NM (United States), 3-5 Jun 1992). Order Number DE93002474. Source: OSTI; NTIS; GPO Dep.

We combine a numerical, boundary element method with analytical techniques to predict the motion of isolated, nonspherical particles moving at low Reynolds number through a Newtonian fluid. The boundary element method is used to determine the constant components of the resistance matrix (a geometry specific matrix relating a particle's linear and angular velocities to the applied forces and torques). Once the resistance matrix has been constructed, direct simulation of the translation and rotation of the particle in streaming flow can be performed. Applications in aerosol characterization have led us to do this analysis for chain-agglomerate particles. We obtain excellent agreement with the limited, published, experimental data.

6848 (SAND–92-1707C) **PCTH: A 3-D MIMD version of the CTH shock physics code.** Robinson, A.C. Sandia National Labs., Albuquerque, NM (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9211128–2: 1992 nuclear explosives code developers conference, Sunnyvale, CA (United States), 2-6 Nov 1992). Order Number DE93004045. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The PCTH (Parallel CTH) solid dynamics code is being built at Sandia National Laboratories based on the algorithms found in the CTH hydrocode. The PCTH code is currently being developed with the MIMD nCUBE and Intel hypercubes as primary development platforms. However, the work is emphasizing the capability to port rapidly to other message passing architectures as well. Major portions of the PCTH system are written in the object-oriented language C++. Examples are give to illustrate the use of object-oriented concepts to simplify the task of MIMD computing. In addition, a detailed description of the tracer particle algorithm as currently implemented in the code is given and used to illustrate object-oriented an MIMD computing concepts. Current performance issues are also summarized.

6849 (UCRL-JC–105642-Rev.1) **Relativistic shock waves and the excitation of plerions: Revision 1.** Arons, J. (California Univ., Berkeley, CA (United States). Theoretical Astrophysics Center); Gallant, Y.A.; Langdon, A.B.; Yang, T.-Y.B. Lawrence Livermore National Lab., CA (United States). 17 Jul 1992. 14p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract W-7405-ENG-48. Grant AST-9115093. (CONF-9202117–7-Rev.1: Physics of isolated pulsars workshop, Taos, NM (United States), 23-28 Feb 1992). Order Number DE93003469. Source: OSTI; NTIS; GPO Dep.

In relativistic shocks, the mechanisms of high energy particle acceleration and of basic thermalization can be one and the same –accelerating relativistic particles can be part of the problem of shock structure itself. In fact, the highest energy electrons and positrons in the shock theory we outline below are those which have Larmor radii comparable to the gyro-radii of the heavy ions which control the shock thickness, and are precisely the $e\pm$ which give rise to the highest energy synchrotron photons observed in the nebular spectrum. Thus, the problems of shock structure and of nonthermal particle acceleration are one and the same.

6850 (UCRL-JC–110144) **OPAL opacities.** Rogers, F.J.; Iglesias, C.A. Lawrence Livermore National Lab., CA (United States). Aug 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9208181–1: GOND 1992: seismic investigation of the sun and stars, Boulder, CO (United States), 11-14 Aug 1992). Order Number DE93002891. Source: OSTI; NTIS; GPO Dep.

We have continued to improve and update the OPAL opacity code. Addition of intermediate coupling has further increases the opacity over earlier LS coupling results. A corresponding states method has been used to extend the tables in both X and Z. This has allowed the calculation and distribution of extensive opacity tables for several different sets of metal abundance.

6851 (UCRL-JC–111252) **Weibel instabilities in relativistic electron-positron plasmas.** Yang, T.-Y.B. (California Univ., Berkeley, CA (United States)); Gallant, Y.; Arons, J.; Langdon, A.B. Lawrence Livermore National Lab., CA (United States). 20 Jul 1992. 8p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract W-7405-ENG-48. Grant AST-9115093. (CONF-9202117–6: Physics of isolated pulsars workshop, Taos, NM (United States), 23-28 Feb 1992). Order Number DE93003468. Source: OSTI; NTIS; GPO Dep.

Wisps have long been observed in the Crab Nebula. Modern observations reveal a whole series of wisps to the northwest, and at least one much fainter wisp to the southeast. Recently, a conceptual model of the wisps in the Crab Nebula has been proposed based on the shock structure of a relativistic magnetosonic shock wave in a electron-positron-proton plasma. The ion overshoot, downstream compressional oscillations, and possibly the pair overshoot can be identified with the wisps. In this paper, we study the linear stability properties of the Weibel instability, which are collective electromagnetic oscillations driven by pitch-angle anisotropy of the distribution functions. This instability can cause pitch-angle scattering of the charged particles and the isotropization of the distribution functions.

6852 (UCRL-JC–111254) **The Crab nebula's "wisps" as shocked pulsar wind.** Gallant, Y.A. (California Univ., Berkeley, CA (United States). Theoretical Astrophysics Center); Arons, J.; Langdon, A.B. Lawrence Livermore National Lab., CA (United States). 20 Jul 1992. 11p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract W-7405-ENG-48. Grant AST-9115093. (CONF-9202117–8: Physics of isolated pulsars workshop, Taos, NM (United States), 23-28 Feb 1992). Order Number DE93003466. Source: OSTI; NTIS; INIS; GPO Dep.

The Crab synchrotron nebula has been successfully modelled as the post-shock region of a relativistic, magnetized wind carrying

most of the spindown luminosity from the central pulsar. While the Crab is the best-studied example, most of the highest spindown luminosity pulsars are also surrounded by extended synchrotron nebulae, and several additional supernova remnants with "plerionic" morphologies similar to the Crab are known where the central object is not seen. All these objects have nonthermal, power-law spectra attributable to accelerated high-energy particles thought to originate in a Crab-like relativistic pulsar wind. However, proposed models have so far treated the wind shock as an infinitesimally thin discontinuity, with an arbitrarily ascribed particle acceleration efficiency. To make further progress, investigations resolving the shock structure seemed in order. Motivated by these considerations, we have performed "particle-in-cell (PIC) simulations of perpendicularly magnetized shocks in electron-positron and electron-positron-ion plasmas. The shocks in pure electron-positron plasmas were found to produce only thermal distributions downstream, and are thus poor candidates as particle acceleration sites. When the upstream plasma flow also contained a smaller population of positive ions, however, efficient acceleration of positrons, and to a lesser extent of electrons, was observed in the simulations.

6853 (UCRL-JC–111508) **Superconducting tunnel junction x-ray detectors with niobium absorbers and aluminum quasiparticle traps: Volume 1743.** Labov, S.E. (Lawrence Livermore National Lab., CA (United States)); Mears, C.A.; Morris, G.W.; Cunningham, C.E.; LeGros, M.A.; Silver, E.H.; Barfknecht, A.T.; Madden, N.W.; Landis, D.A.; Goulding, F.S.; Bland, R.W.; Laws, K.E. Lawrence Livermore National Lab., CA (United States). [1992]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-91ER81109 ;W-7405-ENG-48. (CONF-920792–42: Society of Photo-Optical Instrumentation Engineers (SPIE) international symposium on optical applied science and engineering, San Diego, CA (United States), 19-24 Jul 1992). Order Number DE93002885. Source: OSTI; NTIS; GPO Dep.

We are developing superconducting tunnel junction devices for use as high-resolution, high-efficiency x-ray spectrometers. We have tested devices with niobium x-ray absorbing layers coupled to aluminum layers which serve as quasiparticle traps. These devices were fabricated photolithographically using a modified niobium/aluminum/niobium trilayer fabrication process. Our first devices have a very thin barrier with specific normal state resistance of 1.5 $\times 10^{-6}$ Ω cm^2, and also exhibit very low leakage current of 15nA below 200 mK. The energy resolution at 6 keV is 1990 eV FWHM, and is limited both by electronic noise and by the non-linear response of the detector.

6620 Physics of Elementary Particles and Fields

6854 (DOE/ER/40150–195) **HUGS at CEBAF: Proceedings.** Maung, Khin Maung (Hampton Univ., VA (United States)); Buck, W.W. (eds.). Southeastern Universities Research Association, Inc., Newport News, VA (United States). Continuous Electron Beam Accelerator Facility. [1991]. 214p. Sponsored by USDOE, Washington, DC (United States); National Aeronautics and Space Administration, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract AC05-84ER40150 ;FG05-87ER40380. (CONF-9105388–: Hampton University Graduate Studies (HUGS) at the Continuous Electron Beam Accelerator Facility (CEBAF), Hampton, VA (United States), 29 May - 16 jun 1991). Order Number DE93000830. Source: OSTI; NTIS; INIS; GPO Dep.

This is the proceedings of the 6th consecutive Hampton University Graduate Studies (HUGS) at the Continuous Electron Beam Accelerator Facility (CEBAF). These proceedings are composed of articles produced by graduate students. The participants were divided into smaller groups. Each group chose a lecturer's presentation to focus on and write up for these proceedings. There were some cross over students; that is there were students who participated in more am one group. In addition, there were participants who pursued topics considerably further than being confined to the scope of a given lecture; these participants contributed additional articles which can also be found here. All of the HUGS at CEBAF participants worked very hard and had a good time doing it. The students lived on the Hampton University campus and attended lecture sessions at CEBAF. The atmosphere of the river front campus of Hampton and the stimulation readily available at CEBAF made for a wonderful mix. These proceedings are divided into two sections: Section 1 contain articles that were generated by the HUGS participants from lecturers' notes and discussions among the student groups and lecturers, and Section 2 contains original work generated by the HUGS participants. Section 3 contains the contributions from the lecturers. Some of the articles were reviewed by the lecturer more closely connected to the particular subject matter. The appendices contain a list of the HUGS enrollment, lecturers, schedule, and lecture assignment.

6855 (DOE/ER/40319–T2) **Task A, High Energy Physics Program experiment and theory: Task B, High Energy Physics Program numerical simulation of quantum field theories: Progress report, July 1, 1991–June 30, 1992.** Florida State Univ., Tallahassee, FL (United States). Dept. of Physics. [1992]. 69p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-87ER40319. Order Number DE93004641. Source: OSTI; NTIS; INIS; GPO Dep.

The effort of the experimental group has been concentrated on the CERN ALEPH and FERMILAB D0 collider experiments and completion of two fixed target experiments. The BNL fixed target experiment 771 took the world's largest sample of D(1285) and E/iota(1420) events, using pion, kaon and antiproton beams. Observing the following resonances: $0^{\mp}$ [1280], 1^{++} [1280], $0^{\mp}$ [1420], $0^{\mp}$ [1470], $1^{\pm}$ [1415]. The Fermilab fixed target experiment E711, dihadron production in pN interactions at 800 GeV, completed data reduction and analysis. The atomic weight dependence, when parameterized as $\sigma(A) = \sigma_0 A^{\alpha}$, yielded a value of $\alpha = 1.043 \pm 0.011 \pm .012$. The cross section per nucleon and angular distributions was also measured as a function of two particle mass and agrees very well with QCD calculations. The D0 Fermilab Collider Experiment E740 began its first data taking run in April 1992. The CERN collider experiment ALEPH at LEP is presently taking more data. The Z mass and width, the couplings to the upper and lower components of the hadronic isospin doublet, forward-backward asymmetries of hadronic events, and measurements of the fragmentation process have been made. The effort of detector development for the SSC has substantially increased with particular emphasis on scintillators, both in fibers and plates. Work has continued on higher-order QCD calculations using the Monte Carlo technique developed previously. This year results for WW, ZZ, WZ, and $\gamma\gamma$ production have been published. A method for incorporating parton showering in such calculations was developed and applied to W production. The multicanonical Monte Carlo algorithm has stood up to the promises anticipated; it was used in multicanonical simulations of first-order phase transitions and for spin glass systems.

6856 (DOE/ER/40633–2) **High Energy Physics Program at Texas A and M University: Annual report, November 1, 1991–October 31, 1992.** Texas A and M Univ., College Station, TX (United States). Dept. of Physics. Nov 1992. 291p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-91ER40633. Order Number DE93005112. Source: OSTI; NTIS; INIS; GPO Dep.

The high energy physics program has continued its experimental activities over. In CDF, the Texas A&M group has led an effort to design an upgrade for the silicon vertex detector, and is currently working with the rest of the collaboration on the next major data taking run. In MACRO, work was done on the development of the final version of the wave form digitizing system being implemented for the entire scintillator system. This work is nearing completion, and the system is expected to be up and running on the detector by summer 1993. Work was done within the SDC group to develop gas microstrip chambers for use in precision tracking at the SSC, and in the GEM group, toward the development of a suitable forward calorimeter design. The theoretical high energy physics program has continued the study of a very successful string-derived model that unifies all known interactions: flipped SU(5), which is the leading candidate for a TOE. Work has also continued on some generalizations of the symmetries of string theory, known

as W algebras. These are expected to have applications in two-dimensional conformal field theory, two-dimensional extensions of gravity and topological gravity and W-string theory.

6857 (FNAL/C–92/259) **Using workstation GUIs in HEP, X-Windows, Motif and the Nirvana project.** Edel, M. (Fermi National Accelerator Lab., Batavia, IL (United States)); Kryiakopoulos, J.; Lebrun, P.; Ren, B.; Kallenbach, J.; Iourcha, K. Fermi National Accelerator Lab., Batavia, IL (United States). Oct 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-920966–12: 10. conference on computing in high energy physics, Annecy (France), 21-25 Sep 1992). Order Number DE93004409. Source: OSTI; NTIS; INIS; GPO Dep.

We present four small, high quality, Motif based tools for high energy physicists and discuss some of the less obvious work that is necessary to fully take advantage of graphical user interfaces (GUIs). Histo-Scope and NPlot are interactive data display programs. Histo-Scope is for viewing data as it is collected in running analysis or data acquisition programs, NPlot, for plotting data from text files. Visajet is an interface for the ISAJET event simulation program. It gives users a fast way to configure ISAJET and displays ISAJET events in a three dimensional phase space display that users can rotate and manipulate with the mouse. NEdit is a GUI style plain text editor.

6858 (INIS-mf–14107) **Max-Planck-Institute for Physics, Werner-Heisenberg-Institute. Annual report 1991.** Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany). Werner-Heisenberg-Inst. fuer Physik. Apr 1992 157p. (In German). Order Number DE93750942. Source: OSTI; NTIS (US Sales Only); INIS.

The projects carried out by the department of theoretical physics comprise a broad spectrum of current and fundamental problems of elementary particle physics, especially the interaction of the two. The examinations carried out by the department of experimental physics concern themselves with the production and transformation processes of elementary particles, their features, interactions and their underlying physical laws. This includes the construction of detectors such as HEGRA for high-energy cosmic ray detection. Problems from the area of condensed matter were also dealt with. (DG).

6621 General Theory of Particles and Fields

Refer also to citation(s) 6276, 6305, 6803, 6886, 6890, 6910

6859 (ANL-HEP-CP–92-103) **A streamlined method for chiral fermions on the lattice.** Bodwin, G.T. (Argonne National Lab., IL (United States). High Energy Physics Div.); Kovacs, E.V. Argonne National Lab., IL (United States). High Energy Physics Div. 10 Nov 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9209276–4: LATTICE '92: lattice field theory, Amsterdam (Netherlands), 15-19 Sep 1992). Order Number DE93004857. Source: OSTI; NTIS; INIS; GPO Dep.

We discussed the use of renormalization counterterms to restore the chiral gauge symmetry in a lattice theory of Wilson fermions. We show that a large class of counterterms can be implemented automatically by making a simple modification to the fermion determinant.

6860 (CBPF-NF–030/91) **Critical surface of the quenched bond-diluted cubic model in self-dual lattice: renormalisation group approach.** Silva, E.P. da; Tsallis, C. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1991. [16] Order Number DE93609914. Source: OSTI; NTIS (US Sales Only); INIS.

We propose a quite simple real space renormalisation group which enables us to calculate (for the first time as far as we know, and presumably with high precision) the critical surface of the quenched bond-diluted discrete N-vector ferromagnet. (author).

6861 (CBPF-NF–035/91) **On the Dirac equation in three dimensions.** Linhares, C.A. (Centro Tecnico Aeroespacial (CTA-IEAv), Sao Jose dos Campos, SP (Brazil). Inst. de Estudos Avancados); Mignaco, J.A. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1991. [19] Order Number DE93609915. Source: OSTI; NTIS (US Sales Only); INIS.

We argue that, in three dimensions, spinors should have four components as a consequence of the algebraic structure realized from the Clifford algebra related to the Dirac equation. (author).

6862 (DESY–92-118) **Selberg trace formula for bordered Riemann surfaces: Hyperbolic, elliptic and parabolic conjugacy classes, and determinants of Maass-Laplacians.** Bolte, J. (Hamburg Univ. (Germany). 2. Inst. fuer Theoretische Physik); Grosche, C. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). Aug 1992. 30p. (SISSA–139/92/FM). Order Number DE93742854. Source: OSTI; NTIS (US Sales Only); INIS.

The Selberg trace formula for automorphic forms of weight m ϵ Z, on bordered Riemann surfaces is developed. The trace formula is formulated for arbitrary Fuchsian groups of the first kind which include hyperbolic, elliptic and parabolic conjugacy classes. In the case of compact bordered Riemann surfaces we can explicitly evaluate determinants of Maass-Laplacians for both Dirichlet and Neumann boundary-conditions, respectively. Some implications for the open bosonic string theory are mentioned. (orig.).

6863 (DOE/ER/40617–129) **Vacuum structure of pure gauge theories on the lattice.** Haymaker, R.W. (Louisiana State Univ., Baton Rouge, LA (United States). Dept. of Physics and Astronomy); Singh, V.; Browne, D.; Wosiek, J. Louisiana State Univ., Baton Rouge, LA (United States). Dept. of Physics and Astronomy. [1992]. 14p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract FG05-91ER40617. Grant NSF-DMR-9020310. (CONF-9206280–3: Workshop on QCD vacuum structure, Paris (France), 1-5 Jun 1992). Order Number DE93001920. Source: OSTI; NTIS; INIS; GPO Dep.

Results from simulations on two aspects of quark confinement in the pure gauge sector are presented. First is the calculation of the profile of the flux tube connecting a static $q\bar{q}$ pair in SU(2). By use of the Michael sum rules as a constraint, evidence is set forth that the energy density at the center of the flux tube goes to a constant as a function of quark- separation. Slow variation of the width and energy density is not ruled out. Secondly in the confined phase of lattice U(l), the curl of the magnetic monopole current is calculated, and it is shown that the dual London equation is satisfied and that the electric fluxoid is quantized.

6864 (GSI–92-59(prepr.)) **Relativistic Coulomb-distorted plane waves.** Hofmann, C. (Frankfurt Univ. (Germany). Inst. fuer Theoretische Physik); Augustin, J.; Schaefer, A.; Greiner, W.; Soff, G. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany). Sep 1992. 16p. Order Number DE93742798. Source: OSTI; NTIS (US Sales Only); INIS.

Based on the asymptotic behaviour of the non-relativistic scattering wave functions we present a simple formalism for calculating the scattering solutions of the Dirac equation for a Coulomb potential. The solutions to positive energy and negative energy have to be determined separately. (orig.).

6865 (GSI–92-61(prepr.)) **Diagonalization of propagators in thermo field dynamics for relativistic quantum fields.** Henning, P.A. (Alberta Univ., Edmonton, AB (Canada). Theoretical Physics Inst.); Umezawa, H. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany). Sep 1992. 45p. Order Number DE93742800. Source: OSTI; NTIS (US Sales Only); INIS.

Two-point functions for interacting quantum fields in statistical systems can be diagnolized by matrix transformations. It is shown, that within the framework of time-dependent Thermo Field Dynamics this diagonalization can be understood as a thermal Bogoliubov transformation to non-interacting statistical quasi-particles. The condition for their unperturbed propagation relates these states to the thermodynamic properties of the system: It requires global equilibrium for stationary situations, or specifies the time evolution according to a kinetic equation. (orig.).

6866 (IFT-P–002/92) **On the derivation of causal propagators for algebraic gauges from the principle of analytic extension.** Pimentel, B.M.; Suzuki, A.T.; Tomazelli, J.L. Instituto de

Fisica Teorica (IFT), Sao Paulo, SP (Brazil). 1992. [9] Order Number DE93609884. Source: OSTI; NTIS (US Sales Only); INIS.

The principle of analytic continuation can be used to derive causal distributions for covariant propagators. We apply this principle as a basis for deriving analytically continued causal distributions for algebraic non-covariant propagators. (author).

6867 (IFT-P–003/92) **A new deformation of W-infinity and applications to the two-loop WZNW and conformal affine Toda models.** Aratyn, H. (Illinois Univ., Chicago, IL (United States). Dept. of Physics); Ferreira, L.A.; Gomes, J.F.; Zimerman, A.H. Instituto de Fisica Teorica (IFT), Sao Paulo, SP (Brazil). Jan 1992. [10] Order Number DE93609916. Source: OSTI; NTIS (US Sales Only); INIS.

We constructed a center less W-infinity type of algebra in terms of a generator of a center less Virasoro algebra and an Abelian spin-1 current. This algebra conventionally emerges in the study of pseudo-differential operators on a circle or alternatively within KP hierarchy with Watanabe's bracket. Construction used here is based on a special deformation of the algebra w_∞ of area preserving diffeomorphisms of a 2-manifold. We show that this deformation technique applies to the two-loop WZNW and conformal affine Toda models, establishing henceforth W ∞ invariance of these models. (author).

6868 (IFT-P–020/92) **On two-current realization of KP hierarchy.** Aratyn, H. (Illinois Univ., Chicago, IL (United States). Dept. of Physics); Ferreira, L.A.; Gomes, J.F.; Zimerman, A.H. Instituto de Fisica Teorica (IFT), Sao Paulo, SP (Brazil). Jun 1992. [30] Order Number DE93609917. Source: OSTI; NTIS (US Sales Only); INIS.

A simple description of the KP hierarchy and its multi-Hamiltonian structure is given in terms of two Bose currents. A deformation scheme connecting various W-infinity algebras and relation between two fundamental nonlinear structures are discussed. Properties of Faa di Bruno polynomials are extensively explored in this construction. Applications of our method are given for the Conformal Affine Toda model, WZNW models and discrete KP approach to Toda lattice chain. (author).

6869 (IFT-P–026/92) **Connection between the Affine and conformal Affine Toda models and their Hirota's solution.** Constantinidis, C.P.; Ferreira, L.A.; Gomes, J.F.; Zimerman, A.H. Instituto de Fisica Teorica (IFT), Sao Paulo, SP (Brazil). 1992. [9] Order Number DE93609918. Source: OSTI; NTIS (US Sales Only); INIS.

It is shown that the Affine Toda models (AT) constitute a gauge fixed version of the Conformal Affine Toda model (CAT). This result enables one to map every solution of the AT models into an infinite number of solutions of the corresponding CAT models, each one associated to a point of the orbit of the conformal group. The Hirota's τ-function are introduced and soliton solutions for the AT and CAT models associated to SL (r+1) and SP (r) are constructed. (author).

6870 (IFT-P–028/92) **Complex Kohn variational principle for the solution of Lippmann-Schwinger equations.** Adhikari, S.K. Instituto de Fisica Teorica (IFT), Sao Paulo, SP (Brazil). Jul 1992. [15] Order Number DE93609885. Source: OSTI; NTIS (US Sales Only); INIS.

A recently proposed version of the Kohn variational principle for the t matrix incorporating the correct boundary condition is applied for the first time to the study of nucleon-nucleon scattering. Analytic expressions can be obtained for all the integrals in the method for a wide class of potentials and for a suitable choice of trial functions. Closed-form analytic expressions for these integrals are given for Yakawa and exponential potentials. Calculations with two commonly used S-wave nucleon-nucleon potentials show that the method may converge faster than other solution schemes not only for the phase-shifts but also for the off-shell t matrix elements if the freedom in the choice of the trial function is exploited. (author).

6871 (INIS-SU–321/A, pp. 3-132) **Chiral models: geometric aspects.** Perelomov, A.M. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (Russian Federation). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki. 1989. [214] (In Russian). In *Elementary particles. Issue 2: 13. School of ITEF physics. Collection of scientific researches.* Order Number DE93609886. Source: OSTI; NTIS (US Sales Only); INIS.

A review on nonsupersymmetric and supersymmetric chiral models is presented. The main attention is paid to geometric aspects of the Calabi-Yau varieties. Instanton solutions of the chiral models with nontrivial topology, the Kahler Ricci-plane varieties in particular, are considered. 197 refs.

6872 (INIS-SU–321/A, pp. 133-189) **Superstring as a model of fundamental interactions.** Morozov, A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (Russian Federation). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki. 1989. [214] (In Russian). In *Elementary particles. Issue 2: 13. School of ITEF physics. Collection of scientific researches.* Order Number DE93609886. Source: OSTI; NTIS (US Sales Only); INIS.

A review of the structure of superstring scenario and its place in modern theoretical physics is presented. Superstring provided a new and substantiated hope for the development of a unified theory of fundamental interactions. It describes modification of space-time concepts for supershort distances ($\approx 1/M_p$, where M_p is the particle mass) and self-consistent quantum generalization of the Einstein gravitation, purely geometrical and in certain terms very natural. The theory has great potentialities for its further development. 25 refs.; 7 figs.; 1 tab.

6873 (INIS-SU–321/A, pp. 190-212) **The effective action for massless fields in string theories.** Tsejtlin, A.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (Russian Federation). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki. 1989. [214] (In Russian). In *Elementary particles. Issue 2: 13. School of ITEF physics. Collection of scientific researches.* Order Number DE93609886. Source: OSTI; NTIS (US Sales Only); INIS.

Various approaches to the calculation of the effective action (EA) in the framework of formalism of primarily quantized string theory are described. Explicit results for EA in different string theories are presented. S-matrix procedure for the calculation of EA in the framework of the theory of open boson strings and superstrings are described. For sigma model EA is given in the form of a continuous integral. 23 refs.

6874 (INS–918) **Spontaneous symmetry breaking in QCD.** Yamada, Hirofumi. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Mar 1992. 25p. Order Number DE93753080. Source: OSTI; NTIS; INIS.

We study dynamical chiral symmetry breaking in QCD by the use of the generalized Hartree-Fock method. The low energy quark mass is calculated to the second order of diagrammatic expansion around shifted perturbative vacuum where quarks are massive. We show that the low energy mass is finite and renormalization group invariant. We find that the finite mass gap emerges as the solutions of gap equation and stationarity condition, thereby breaking the chiral symmetry. We also discuss the possibility that the breaking solution may exist up to all orders. (author).

6875 (INS–932) **Dimensional transition of the space-time at the minimum action near the planck scale.** Terazawa, Hidezumi. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. May 1992. 13p. Order Number DE93754192. Source: OSTI; NTIS; INIS.

In a model of the extended n-dimensional Einstein-Hilbert action for space-time and matter, it is suggested that the space-time (or universe), when contracted, may transit into a new one of higher or lower dimensions at the minimum action near the Planck scale. (author).

6876 (INS-T–513) **Proceedings of the workshop on new aspects of quantum field theories.** Nojiri, Shin-ichi (ed.). Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Sep 1992. 200p. (CONF-9202146–: Workshop on new aspects of quantum field theories, Tanashi (Japan), 17-19 Feb 1992). Order Number DE93754136. Source: OSTI; NTIS; INIS.

This issue is the collection of the papers presented at the title meeting. The 4 of the presented papers are indexed individually. (J.P.N.).

6877 (ITP–91-26) **Differential equations method: the calculation of N (N>2)-points diagrams.** Kotikov, A.V. AN Ukrainskoj SSR, Kiev (Ukraine). Inst. Teoreticheskoj Fiziki. 1991. [12] Order Number DE93609887. Source: OSTI; NTIS (US Sales Only); INIS.

We expand the earlier invented method of massive Feynman diagrams calculation, namely, the differential equations method, to N-point diagrams. We obtain a simple algorithm which allows us to reduce the vertex-type diagram to the propagator-type diagrams, the box-type diagram to the vertex-type diagrams and, in general, the N-point diagram to the (N-1)-point diagrams. We show that this method provides a simple procedure of evaluating the result without D-space integrals (for the dimensional regularization) calculation. 15 refs. (author).

6878 (LA-UR–92-3479) **Lectures on 2D gravity and 2D string theory.** Ginsparg, P. (Los Alamos National Lab., NM (United States)); Moore, G. Los Alamos National Lab., NM (United States). 17 Sep 1992. 86p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36 ;AC02-76ER03075. (CONF-9206314–1: TASI summer school, Boulder, CO (United States), 11-29 Jun 1992; YCTP-P–23-92). Order Number DE93003746. Source: OSTI; NTIS; INIS; GPO Dep.

This report the following topics: loops and states in conformal field theory; brief review of the Liouville theory; 2D Euclidean quantum gravity I: path integral approach; 2D Euclidean quantum gravity II: canonical approach; states in 2D string theory; matrix model technology I: method of orthogonal polynomials; matrix model technology II: loops on the lattice; matrix model technology III: free fermions from the lattice; loops and states in matrix model quantum gravity; loops and states in the C=1 matrix model; 6V model fermi sea dynamics and collective field theory; and string scattering in two spacetime dimensions.

6879 (UM-P–91/61) **Uncertainties in the Foldy-Wouthuysen transformation.** Wu, Dandi. Melbourne Univ., Parkville, VIC (Australia). School of Physics. Aug 1991. [7] (SSCL–499.). Order Number DE93609879. Source: OSTI; NTIS (US Sales Only); INIS.

The Foldy-Wouthuysen (W-F) transformation is designed to transform the Hamiltonian of a fermion to a block diagonalized one in order to make the physical contents explicit. At the limit of zero interaction, this diagonalization can be done completely. With interactions. the diagonalization is incomplete and can be done only in the nonrelativistic limit to the extent of neglecting higher orders of 1/m where m is the mass of the fermion. Although the F-W transformations are not uniquely defined in either case, the ambiguity in the final results appears only in the case of incomplete diagonalization. For some very special interactions, this ambiguity has been studied, however, this article will show that the ambiguity exists in general. Therefore, care must be taken when displaying the physical contents of an interacting Hamiltonian by F-W transformation. Extra information must be invoked to guarantee the unique and correct result.

6880 (UM-P–91/70) **The physical interpretation of mass as rest-frame frequency.** Wignall, J.W.G. Melbourne Univ., Parkville, VIC (Australia). School of Physics. Jan 1992. [15] Order Number DE93609880. Source: OSTI; NTIS (US Sales Only); INIS.

It is shown that, if one regards particles as spatially extended periodic disturbances in a classical background field, with a simple interaction in which charged particles are modulated by photons, then the angular frequency of a free-particle disturbance in its rest frame has the inertial property required of mass. Quantitative development of this picture provides a unified derivation, on the one hand, of classical equations of motion such as Newton's Second Law and the Lorentz force and, on the other, of the Dirac and Schroedinger equations for a particle in a potential. Some remarks are made on the problem of establishing the other key property of mass, namely its additivity, within this approach. 1 fig.

6881 (UM-P–91/93) **Random walks and a simple chirally invariant lattice Hamiltonian without fermion doubling.** Belyea, C.I. Melbourne Univ., Parkville, VIC (Australia). School of Physics. [1992]. [11] (OZ–91/20.). Order Number DE93609920. Source: OSTI; NTIS (US Sales Only); INIS.

It is shown that there is a simple chirally-invariant lattice Hamiltonian for fermions which is doubling-free but non-Hermitian and which may be valuable in lattice Hamiltonian studies of quantum chromodynamics. A connection is established between the existence of random walk representations of spinor propagators and this doubling-free formulation, in analogy with Wilson fermions. 15 refs.

6882 (UM-P–91/108) **Exotic fermions in the left-right symmetric model.** Choi, J.; Volkas, R.R. Melbourne Univ., Parkville, VIC (Australia). School of Physics. [1992]. [25] Sponsored by Australian Research Council, Canberra, ACT (Australia). (OZ–91/21.). Order Number DE93609919. Source: OSTI; NTIS (US Sales Only); INIS.

A systematic study is made of non-standard fermion multiplets in left-right symmetric models with gauge group $SU(3)_x$ $SU(2)_L$ x $SU(2)_R$ x $U(1)_{BL}$. Constraints from gauge anomaly cancellation and invariance of Yukawa coupling terms are used to define interesting classes of exotic fermions. The standard quark lepton spectrum of left-right symmetric models was identified as the simplest member of an infinite class. Phenomenological implications of the next simplest member of this class are then studied. Classes of exotic fermions which may couple to the standard fermions through doublet Higgs bosons were also considered, then shown that some of these exotics may be used to induce a generalised universal see-saw mechanism. 12 refs., 1 tab.

6883 (UM-P–92/04) **Scalar symmetry of the massless Dirac equation.** Clerk, G.J.; McKellar, B.H.J. Melbourne Univ., Parkville, VIC (Australia). School of Physics. [1992]. [8] Sponsored by Australian Research Council, Canberra, ACT (Australia). (OZ-P–92/03.). Order Number DE93609921. Source: OSTI; NTIS (US Sales Only); INIS.

The existence of a symmetry of the Dirac equation for a massless particle in a scalar field is demonstrated, and its effect on the band structure of certain arrays of scalar δ-function potentials is investigated. The implications of the symmetry for more general scalar potentials are also discussed. 10 refs.

6884 (UM-P–92/20) **A universal mass in (2+1)-dimensions.** Cornish, N.J.; Frankel, N.E. Melbourne Univ., Parkville, VIC (Australia). School of Physics. [1992]. [12] Order Number DE93609888. Source: OSTI; NTIS (US Sales Only); INIS.

By combining Einstein's field equations in an unconventional way, and invoking the reasonable energy hypothesis, it was proved that all extended structures in hydrostatic equilibrium have the same maximal mass and produce spacetime that are asymptotically cylindrical when local curvature is present. 6 refs.

6885 (UM-P–92/58) **Wavefront reconstruction from three dimensional intensity measurements.** Nugent, K.A.; Roberts, A. Melbourne Univ., Parkville, VIC (Australia). School of Physics. [1992]. [10] Sponsored by Australian Research Council, Canberra, ACT (Australia). Order Number DE93609881. Source: OSTI; NTIS (US Sales Only); INIS.

In this paper it is shown that is is possible to use intensity measurements taken in a series of planes perpendicular to some axis to produce full four-dimensional information about the cross spectral density function. This measurement of the intensity in any given plane gives a series of slices thorough the four-dimensional Fourier transform of the Brightness function. For a coherent field, this information also enables us to calculate the phase and amplitude of the electric field in any given plane. If a finite measurement range is taken, the resolution of the reconstructed field is degraded, but in the limit of measurements taken over an infinite range, the full Fresnel field can be calculated. When considering the practical application of this technique to real data, the delta function definition needs to be redefined in terms of a 'top-hat' function. This does not alter any of the central conclusions obtained using delta functions, but enables the production of an algorithm for the reconstruction of the electric field from real intensity measurements. This was applied to a simulation of the simple case of a Gaussian beam. The reconstructed phase and amplitude of the electric field so obtained were in good agreement with assumed values. 14 refs., 5 figs.

6622 Specific Theories and Interaction Models; Particle Systematics

Refer also to citation(s) 6377, 6816, 6817, 6874, 6948, 7015, 7022, 7180

6886 (ANL-HEP-CP-92-90) **Color sextet quarks and new high-energy interactions.** White, A.R. (Argonne National Lab., IL (United States)); Kang, Kyungsik. Argonne National Lab., IL (United States). High Energy Physics Div. 28 Oct 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (BROWN-HET-883;CONF-9206284-2: 7. international symposium on very high energy cosmic ray interactions, Ann Arbor, MI (United States), 21-27 Jun 1992). Order Number DE93004187. Source: OSTI; NTIS; INIS; GPO Dep.

We review the implications of adding a flavor doublet of color sextet quarks to QCD. Theoretical attractions include – "minimal" dynamical symmetry breaking of the electroweak interaction, solution of the Strong CP problem via the "heavy axion" η_6, and Critical Pomeron Scaling at asymptotic energies. Related experimental phenomena, which there may be evidence for, include – production of the η_6 at LEP, large cross-sections for W^+W^- and Z^oZ^o pairs and very high energy jets in hadron colliders, and a hadronic threshold above which high-energy "exotic" diffractive processes appear in Cosmic Ray events.

6887 (ANL-HEP-CP-92-92) **Hadron spectrum of quenched QCD on a $32^3 \times 64$ lattice.** Kim, Seyong; Sinclair, D.K. Argonne National Lab., IL (United States). High Energy Physics Div. Oct 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9209276-3: LATTICE '92: lattice field theory, Amsterdam (Netherlands), 15-19 Sep 1992). Order Number DE93004157. Source: OSTI; NTIS; INIS; GPO Dep.

Preliminary results from a hadron spectrum calculation of quenched Quantumchromodynamics on a $32^3 \times 64$ lattice at $\beta = 6.5$ are reported. The hadron spectrum calculation is done with staggered quarks of masses, $m_q a = 0.001$, 0.005 and 0.0025. We use two different sources in order to be able to extract the Δ mass in addition to the usual local light hadron masses. The numerical simulation is executed on the Intel Touchstone Delta computer. The peak speed of the Delta for a 16×32 mesh configuration is 41 Gflops for 32 bit precision. The sustained speed for our updating code is 9.5 Gflops. A multihit metropolis algorithm combined with an over-relaxation method is used in the updating and the conjugate gradient method is employed for Dirac matrix inversion. Configurations are stored every 1000 sweeps.

6888 (ANL-HEP-CP-92-109) **Rigorous QCD predictions for decays of P-wave quarkonia.** Bodwin, G.T. (Argonne National Lab., IL (United States). High Energy Physics Div.); Braaten, E.; Lepage, G.P. Argonne National Lab., IL (United States). High Energy Physics Div. Nov 1992. 4p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract W-31109-ENG-38 ;FG02-91ER40684. (CONF-921122-8: Meeting of the Division of Particles and Fields of the American Physics Society, Batavia, IL (United States), 10-14 Nov 1992). Order Number DE93004853. Source: OSTI; NTIS; INIS; GPO Dep.

We present a new factorization theorem for the decay rates of P-wave states of heavy quarkonia. Infrared logarithms that had appeared in previous perturbative calculations of P-wave decays are absorbed into a quantity that is related to the amplitude for the heavy quark and antiquark to be in a relative color-octet S-wave state. We predict all of the light-hadronic and electromagnetic decays rates of the χ_c and h_c states in terms of two phenomenological parameters.

6889 (ANL-HEP-CP-92-113) **QCD with 2 light quark flavours: Thermodynamics on a $16^3 \times 8$ lattice and glueballs and topological charge on a $16^3 \times 32$ lattice.** Sinclair, D.K. HEMCGC collaboration; HTMCGC collaboration. Argonne National Lab., IL (United States). High Energy Physics Div. 20 Nov 1992. 4p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract W-31109-ENG-38 ;FG02-85ER40213 ;FG02-91ER40672 ;FG02-91ER40661 ;FC05-85ER25000 ;FG02-91ER40628. Grant PHY87-01775;Grant PHY91-16964. (CONF-9209276-5: LATTICE '92: lattice field theory, Amsterdam (Netherlands), 15-19 Sep 1992; FSU-SCRI-92C-168). Order Number DE93004858. Source: OSTI; NTIS; INIS; GPO Dep.

The HTMCGC collaboration has been simulating lattice QCD with two light staggered quarks with masses $m_q = 0.0125$ and also $m_q = 0.00625$ on a $16^3 \times 8$ lattice. We have been studying the behavior of the transition from hadronic matter to a quark-gluon plasma and the properties of that plasma. We have been measuring entropy densities, Debye and hadronic screening lengths, the spacial string tension and topological susceptibility in addition to the standard order parameters. The HEMCGC collaboration has simulated lattice QCD with two light staggered quarks, $m_q = 0.025$ and $m_q = 0.010$ on a $16^3 \times 32$ lattice. We have measured the glueball spectrum and topological susceptibilities for these runs.

6890 (BNL-48069) **Uses of the chiral Lagrangian at the SSC.** Dawson, S. Brookhaven National Lab., Upton, NY (United States). Sep 1992. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9206251-3: Physics beyond the standard model III conference, Ottawa (Canada), 22-24 Jun 1992). Order Number DE93003170. Source: OSTI; NTIS; INIS; GPO Dep.

In the event that the SSC does not observe any resonances such as a Higgs boson or a techni-rho meson, we would like to know if the SSC can still discover something about the nature of the electroweak symmetry breaking. In particular, we consider the question of whether there is a "no-lose" corollary at the SSC. We will use chiral Lagrangian techniques to address this question and analyze their utility for studying events containing W and Z gauge bosons at the SSC.

6891 (CONF-9205269-1) **The transverse profile of a color flux tube.** Wong, Cheuk-Yin; Gatoff, G. Oak Ridge National Lab., TN (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Realistic nuclear structure; Stony Brook, NY (United States); 28-30 May 1992. Order Number DE93002424. Source: OSTI; NTIS; INIS; GPO Dep.

The P_t spectra of soft mesons produced in high energy collisions contain information on the transverse motion of quarks and antiquarks which form these mesons. Using these data, we study the transverse profile of the color flux tube in the context of the Schwinger's mechanism for particle production by representing the transverse profile in terms of an effective transverse scalar potential. We find that the classical turning point for the potential is of the order of 0.6 fm. However, the potential flattens out considerably beyond that point. Consequently, the wave function decays surprisingly slowly in the transverse direction as $r^{-3/2}$ and extends much beyond the radius of the flux-tube.

6892 (CONF-9207169-1) **Effect of quark-gluon plasma boundary on the momentum distribution of quarks.** Wong, Cheuk-Yin. Oak Ridge National Lab., TN (United States). [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 22. international symposium on multiparticle dynamics; Santiago de Compostela (Spain); 13-17 Jul 1992. Order Number DE93004166. Source: OSTI; NTIS; INIS; GPO Dep.

The boundary of a quark-gluon plasma affects the momentum distribution of quarks in the plasma. In particular, a transverse boundary leads to a transverse momentum distribution with a shape different from the thermal distribution especially in the high transverse momentum region. In consequence, boundary effect must be taken into account if one wishes to estimate the magnitudes of signals in a search for the quark-gluon plasma.

6893 (DESY-92-102) **On the effect of the tanti t threshold on electroweak parameters.** Kniehl, B.A. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany)); Sirlin, A. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). Sep 1992. 34p. (NYU-TR-92/09/04). Order Number DE93742850. Source: OSTI; NTIS (US Sales Only); INIS.

Threshold effects in $e^+e^- \rightarrow$tanti t induce contributions to key electroweak parameters such as $\Delta\rho$, Δr, and $\sin^2 \theta_w$ beyond the

scope of perturbative calculations of $O(\alpha)$ and $O(\alpha\alpha_s)$. We quantitatively analyze these effects using once-subtracted dispersion relations which manifestly satisfy relevant Ward identities. The derivation and properties of the dispersion relations are discussed at some length. We find that the threshold effects enhance the familiar perturbative $O(\alpha\alpha_s)$ corrections by between 25% and 40%, depending on the t-quark mass. The shift in the predicted value of the W-boson mass due to the threshold effects ranges from -8MeV at m_t=91 GeV to -45 MeV at m_t=250 GeV. (orig.).

6894 (DESY–92-115) **Screening in the lattice Schwinger model.** Dilger, H. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). Aug 1992. 18p. Order Number DE93742852. Source: OSTI; NTIS (US Sales Only); INIS.

We calculate the potential between heavy fermions in the lattice Schwinger model in the euclidean formalism with staggered fermions by an unquenched strong coupling expansion and Monte Carlo simulations. The results are compared with the corresponding continuum expressions including finite size corrections. (orig.).

6895 (DESY–92-117) **On the kinetics of the electroweak phase transition.** Buchmueller, W.; Helbig, T. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). Aug 1992. 14p. Order Number DE93742855. Source: OSTI; NTIS (US Sales Only); INIS.

Talk given at the 15. international Warsaw meeting on elementary particle physics, Kazimierz (Poland), and HLRZ workshop on dynamics of first order phase transitions, Juelich (Germany).

We discuss several aspects of the electroweak phase transition, which is generally believed to be first order. Starting from Langer's theory of metastable states we derive an approximate formula for the decay rate. We then investigate the uncertainties in present evaluations of size and surface tension of critical bubbles and comment on the stumbling blocks on the way towards a quantitative description of the electroweak phase transition. (orig.).

6896 (DOE/ER/40577–3) **[Theoretical studies in elementary particle physics]: Annual technical progress report.** Collins, J. Pennsylvania State Univ., University Park, PA (United States). Dept. of Physics. [1992]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER40577. Order Number DE93005923. Source: OSTI; NTIS; INIS; GPO Dep.

Work on the following topics is summarized: polarized hard scattering, hard diffraction, gauge-invariant operators, fundamental QCD, heavy quarks, strongly interacting Ws, and instanton-induced effects in QCD. Some attention is given to the factorization theorem.

6897 (FNAL/C–92/253-E) **QCD tests with CDF.** Flaugher, B. CDF Collaboration. Fermi National Accelerator Lab., Batavia, IL (United States). Sep 1992. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-920837–10: ICHEP-26: 26th International Union of Pure and Applied Physics (IUPAP) conference on high energy physics, Dallas, TX (United States), 6-12 Aug 1992). Order Number DE93002819. Source: OSTI; NTIS; INIS; GPO Dep.

Measurement of scaling violations, the inclusive photon and diphoton cross sections as well as the photon-jet and jet-jet angular distributions are discussed and compared to leading order and next-to-leading order QCD. A study of four-jet events is described, with a limit on the cross section for double parton scattering. The multiplicity of jets in W boson events is compared to theoretical predictions.

6898 (FNAL/C–92/260) **Software for parallel processing applications.** Wolbers, S. Fermi National Accelerator Lab., Batavia, IL (United States). Oct 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-920966–9: 10. conference on computing in high energy physics, Annecy (France), 21-25 Sep 1992). Order Number DE93002510. Source: OSTI; NTIS; INIS; GPO Dep.

Parallel computing has been used to solve large computing problems in high-energy physics. Typical problems include offline event reconstruction, monte carlo event-generation and reconstruction, and lattice QCD calculations. Fermilab has extensive experience in parallel computing using CPS (cooperative processes software) and networked UNIX workstations for the loosely-coupled problems of event reconstruction and monte carlo generation and CANOPY and ACPMAPS for Lattice QCD. Both systems will be discussed. Parallel software has been developed by many other groups, both commercial and research-oriented. Examples include PVM, Express and network-Linda for workstation clusters and PCN and STRAND88 for more tightly-coupled machines.

6899 (IFT-P–027/92) **Helicity amplitudes for matter-coupled gravity.** Aldrovandi, R.; Novaes, S.F.; Spehler, D. Instituto de Fisica Teorica (IFT), Sao Paulo, SP (Brazil). Jul 1992. [24] Order Number DE93609932. Source: OSTI; NTIS (US Sales Only); INIS.

The Weyl-van der Waerden spinor formalism is applied to the evaluation of helicity invariant amplitudes in the framework of linearized gravitation. The graviton couplings to spin-0, 1_-2, 1, and 3_-2 particles are given, and, to exhibit the reach of this method, the helicity amplitudes for the process electron + positron → photon + graviton are obtained. (author).

6900 (IFT-P–029/92) **On the independent particle approximation of Gauge theories: a simple example.** Palladino, B.E. Instituto de Fisica Teorica (IFT), Sao Paulo, SP (Brazil); Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). Aug 1992. [21] Order Number DE93609939. Source: OSTI; NTIS (US Sales Only); INIS.

In this work, the independent particle model formulation is studied as a mean-field approximation of gauge theories using the path integral approach in the framework of quantum electrodynamics in 1+1 dimensions. It is shown how a mean-field approximation scheme can be applied to fit an effective potential to an independent particle model, building a straightforward relation between the model and the associated gauge field theory. An example is made considering the problem of massive Dirac fermions on a line, the so called massive Schwinger model. An interesting result is found, indicating a behaviour of screening of the charges in the relativistic limit of strong coupling. A forthcoming application of the method developed to confining potentials in independent quark models for QCD is in view and is briefly discussed. (author).

6901 (INIS-BR–3112, pp. 175-244) **Models of the nucleon.** Weise, W. (Regensburg Univ. (Germany). Inst. of Theoretical Physics). Sociedade Brasileira de Fisica, Sao Paulo, SP (Brazil). 1991. [258] (CONF-9102193–: 5. Swieca School in Nuclear Physics, Campos do Jordao (Brazil), 19-28 Feb 1991). In *Proceedings of the 5. Swieca School in Nuclear Physics.* Order Number DE93609952. Source: OSTI; NTIS (US Sales Only); INIS.

Nucleons models and various aspects of nucleon structure are discussed, presenting initially some facts about the nucleon and some aspects of low energy quantum chromodynamics (in particular chiral symmetry and its spontaneous breaking). (M.C.K.).

6902 (INP–1552/PH) **Parton distributions in the small-X region within LLX approximation.** Strozik-Kotlorz, D. Institute of Nuclear Physics, Cracow (Poland). 1991. [34] Order Number DE93609944. Source: OSTI; NTIS (US Sales Only); INIS.

The solutions of Lipatov-Fadin-Kuraev equation (LFK) within LLX approximation for gluon distributions are studied. The results are based on the semiphenomenological boundary conditions taken from LLQ^2 analysis. I find, that pure theoretical LLX approach can reproduce the form of singular small-x behaviour of gluon and seaquark distributions obtained within LLQ^2A with singular input parametrizations. Some remarks about shadowing corrections are presented. (author).

6903 (IYaF–90-71) **REDUCE in elementary particle physics. Quantum electrodynamics.** Grozin, A.G. AN SSSR, Novosibirsk (Russian Federation). Inst. Yadernoj Fiziki. 1990. [82] (In Russian). Order Number DE93609940. Source: OSTI; NTIS (US Sales Only); INIS.

This preprint is the second part of the problem book on using REDUCE for calculations of cross sections and decay probabilities in elementary particle physics. It contains examples of calculations in quantum electrodynamics. 5 refs.

6904 (LA-UR–92-3736) **Lattice analysis of two-point hadronic correlators in the QCD vacuum.** Chu, M.C. (California Inst. of Tech., Pasadena, CA (United States). W.K. Kellogg Lab.);

Grandy, J.M.; Huang, S.; Negele, J.W. Los Alamos National Lab., NM (United States). [1992]. 4p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract W-7405-ENG-36 ;AC02-76ER03069 ;FG06-88ER40427. Grant PHY 88-172967. (CONF-9209276–1: LATTICE '92: lattice field theory, Amsterdam (Netherlands), 15-19 Sep 1992). Order Number DE93003824. Source: OSTI; NTIS; INIS; GPO Dep.

Results from the first lattice QCD analysis of vacuum correlators of local hadronic currents using dispersion relations are presented. We have explored the vector, pseudoscalar, axial, and scalar meson channels, and the proton-like and delta-like baryon channels. The lattice results are shown to agree qualitatively with experimental results in channels where experimental data exist, and shed insight into interacting instanton approximations and sum rule calculations in the other channels.

6905 (LBL–32938) **Complementarity of resonant and nonresonant strong WW scattering at SSC and LHC.** Chanowitz, M.S. Lawrence Berkeley Lab., CA (United States). Aug 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-920837–34: ICHEP-26: 26th International Union of Pure and Applied Physics (IUPAP) conference on high energy physics, Dallas, TX (United States), 6-12 Aug 1992). Order Number DE93004707. Source: OSTI; NTIS; INIS; GPO Dep.

Signals and backgrounds for strong WW scattering at the SSC and LHC are considered. Complementarity of resonant signals in the I = 1 WZ channel and nonresonant signals in the I = 2 W^+W^+ channel is illustrated using a chiral lagrangian with a J = 1 "ρ" resonance. Results are presented for purely leptonic final states in the W±Z, $W^+W^+ + W^-W^-$, and ZZ channels.

6906 (SLAC-PUB–5999) **Aspects of the electroweak phase transition.** Huet, P. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Nov 1992. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-921122–6: Meeting of the Division of Particles and Fields of the American Physics Society, Batavia, IL (United States), 10-14 Nov 1992). Order Number DE93004629. Source: OSTI; NTIS; INIS; GPO Dep.

The electroweak phase transition is reviewed in light of some recent developments. Emphasis is on the issue whether the transition is first or second order and its possible role in the generation of the baryon asymmetry of the universe.

6907 (UM-P–91/86) **Extended weak-isospin and fermion masses in a unified model.** Joshi, G.C.; Volkas, R.R. Melbourne Univ., Parkville, VIC (Australia). School of Physics. [1992]. [32] Sponsored by Australian Research Council, Canberra, ACT (Australia). (OZ–91/12.). Order Number DE93609933. Source: OSTI; NTIS (US Sales Only); INIS.

It is interesting to ask whether the weak isospin gauge group $SU(2)_L$ is embedded in a larger symmetry group. From a model-building perspective there are usually too many possible answers to this question, because extensions invariable introduce new gauge anomalies. New fermions then have to be postulated, usually in an ad hoc manner, to cancel these anomalies. However, the quark-lepton symmetric models of Foot and Lew allow one to extend the weak-isospin group in a disciplined way, because the new anomalies can now cancel between quarks and generalized leptons. The basis of a model with gauge group $G = [SU(3)]^4$ are presented in this paper. It was found that, through left-right symmetry, a partial unification of the gauge coupling constants of the theory naturally suggests itself, and that the symmetries of the model can impose restrictions on fermion masses and mixing angles at tree-level, which renormalization effects and mixing phenomena may modify in a predictive manner. 19 refs.

6908 (UM-P–92/01) **Large contribution to the neutron electric dipole moment from a dimension six four quark operator.** He, Xiaogang; McKellar, B. Melbourne Univ., Parkville, VIC (Australia). School of Physics. [1992]. [10] Sponsored by Australian Research Council, Canberra, ACT (Australia). (OZ–92/01.). Order Number DE93609953. Source: OSTI; NTIS (US Sales Only); INIS.

In this paper the contribution of a dimension six four quark operator (Q_q) to the neutron electric dipole moment was studied. It was found that this contribution dominates over other contributions by at least one order of magnitude in Left-Right symmetric models and two orders of magnitude in di-quark scalar models. 10 refs., 1 fig.

6909 (UM-P–92/02) **Relativistic spin-one bosons in a magnetic field.** Daicic, J.; Frankel, N.E. Melbourne Univ., Parkville, VIC (Australia). School of Physics. [1992]. [19] Order Number DE93609927. Source: OSTI; NTIS (US Sales Only); INIS.

The quantum mechanics of charged, massive, spin-one bosons in the presence of a homogeneous magnetic field is studied using a six-component wave function formalism. The energy eigenvalues are compared to those previously obtained via other formalisms, the equations of motion of certain operators are given, and the positive and negative energy eigensolutions are obtained by the use of a ladder operator method. The six-component current for the case of general external electromagnetic fields is also displayed, and finally the employment of the eigensolutions and current in a study of a spin-one boson-anti boson plasma is discussed. 22 refs.

6910 (UM-P–92/08) **CP violating electron-nucleon interactions in multi-Higgs doublet and leptoquark models.** He, Xiaogang; McKellar, B.H.J. Melbourne Univ., Parkville, VIC (Australia). School of Physics. [1992]. [10] Sponsored by Australian Research Council, Canberra, ACT (Australia); USDOE, Washington, DC (United States). Contract DE-AM03-76F00235. (OZ–92/04.). Order Number DE93609928. Source: OSTI; NTIS (US Sales Only); INIS.

CP violating electron-nucleon interactions and the resulting atomic electric dipole moments (EDM) are studied in several models. It is demonstrated that in the standard model these interactions are very small and are well below the experimental upper bounds. In multi-Higgs doublet models, the four-fermi interactions, can be quite large. In some range of parameters, the contribution of these interactions to the atomic EDM can exceed the contribution of the electron EDM. In leptoquark models the contribution from the tensor interaction is always the dominant one. 20 refs.

6911 (UM-P–92/18) **Unified SU(4) color models in ten dimensions.** Hanlon, B.E.; Joshi, G.C. Melbourne Univ., Parkville, VIC (Australia). School of Physics. [1992]. [32] (OZ–92/09.). Order Number DE93609934. Source: OSTI; NTIS (US Sales Only); INIS.

Some aspects of constructing unified models with SU(4) as the color group via a unifying group defined in ten dimensions are examined. Four dimensional theories are recovered using the Coset Space Dimensional Reduction scheme. Candidate models are considered in order to highlight some of the difficulties in constructing realistic four dimensional theories. 30 refs.

6912 (UM-P–92/42) **Relativistic corrections to the neutron electric dipole moment in valence quark models.** Costella, J.P.; McKellar, B.H.J. Melbourne Univ., Parkville, VIC (Australia). School of Physics. [1992]. [9] Sponsored by Australian Research Council, Canberra, ACT (Australia); USDOE, Washington, DC (United States). Grant DOE/ER40561. Order Number DE93609954. Source: OSTI; NTIS (US Sales Only); INIS.

It is shown that, in valence quark models, the relativistic corrections to the SU(6) relation for the contribution of the electric dipole moments of the quarks to the electric dipole moment of the neutron can be expressed as a multiplicative correction factor. The correction factor is evaluated in light cone wavefunction models, in the bag model, and in relativistic mean-field models, and is found to lie between 1/3 and 1. It is also demonstrated that in these models, there is a linear relation between correction to the SU(6) value for g_A and that for the electric dipole moment. 14 refs.

6913 (UNICAMP-IMECC-RT–18/91) **The strong coupling constant: its theoretical derivation from a geometric approach to hadron structure.** Recami, E.; Tonin-Zanchin, V. Universidade Estadual de Campinas, SP (Brazil). Inst. de Matematica, Estatistica e Ciencia da Computacao. 1991. [16] Order Number DE93609935. Source: OSTI; NTIS (US Sales Only); INIS.

Since more than a decade, a bi-scale, unified approach to strong and gravitational interactions has been proposed, that uses the geometrical methods of general relativity, and yielded results similar

to strong gravity theory's. We fix our attention, in this note, on hadron structure, and show that also the strong interaction strength α s, ordinarily called the (perturbative) coupling-constant square, can be evaluated within our theory, and found to decrease (increase) as the distance r decreases (increases). This yields both the confinement of the hadron constituents for large values of r, and their asymptotic freedom [for small values of r inside the hadron]: in qualitative agreement with the experimental evidence. In other words, our approach leads us, on a purely theoretical ground, to a dependence of α_s on r which had been previously found only on phenomenological and heuristical grounds. We expect the above agreement to be also quantitative, on the basis of a few checks performed in this paper, and of further work of ours about calculating meson mass-spectra. (author).

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Refer also to citation(s) 6276, 6332, 6383, 6391, 6434, 6897, 6951, 6952, 6957, 6963, 6994, 7015

6914 (ANL-HEP-CP–92-79) **Constraints on the gluon density from bottom quark and prompt photon production.** Berger, E.L. (Argonne National Lab., IL (United States)); Meng, R.; Qiu, J. Argonne National Lab., IL (United States). High Energy Physics Div. 15 Aug 1992. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38 ;FG02-92ER40730. (CONF-920837–9: ICHEP-26: 26th International Union of Pure and Applied Physics (IUPAP) conference on high energy physics, Dallas, TX (United States), 6-12 Aug 1992). Order Number DE93002782. Source: OSTI; NTIS; INIS; GPO Dep.

In next-to-leading order quantum chromodynamics, gluon-gluon interactions dominate the production of bottom quarks at hadron collider energies, and gluon-quark interactions control inclusive prompt photon production at large transverse momentum in pp collisions at fixed-target energies. Using such data, in conjunction with data from deep inelastic lepton scattering, we determine a new gluon density whose shape differs substantially from that derived from previous fits of data. The new set of parton densities provides a good fit to bottom quark, prompt photon, and deep inelastic data, including the most recent NMC and CCFR results.

6915 (ANL-HEP-CP–92-85) **Results from the Soudan 2 detector.** Thron, J.L. The Soudan 2 Collaboration. Argonne National Lab., IL (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-920837–8: ICHEP-26: 26th International Union of Pure and Applied Physics (IUPAP) conference on high energy physics, Dallas, TX (United States), 6-12 Aug 1992). Order Number DE93002777. Source: OSTI; NTIS; INIS; GPO Dep.

The Soudan 2 underground detector is a large fine-grained tracking calorimeter comprised of long drift tubes read out by proportional wires. It is surrounded by a proportional tube shield. Preliminary nucleon decay results with 0.5 fiducial kT-yr exposure give 90% CL lower limits of $\tau/B > 4.5 \times 10^{30}$yr for the mode $p \rightarrow K^+\nu$. A search for GUT magnetic monopoles making highly ionizing tracks yielded a 90% CL upper flux limit of 8.7×10^{-15} $cm^{-2}s^{-1}sr^{-1}$ for monopole velocities of $\beta > 2 \times 10^{-3}$ in data taken over almost three years.

6916 (ANL-HEP-CP–92-117) **The η_6 and massive photon pairs at LEP.** White, A.R. (Argonne National Lab., IL (United States). High Energy Physics Div.); Knowles, I.G.; Kang, Kyungsik. Argonne National Lab., IL (United States). High Energy Physics Div. 1 Dec 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-921122–9: Meeting of the Division of Particles and Fields of the American Physics Society, Batavia, IL (United States), 10-14 Nov 1992; BROWN-HET–885). Order Number DE93004850. Source: OSTI; NTIS; INIS; GPO Dep.

The η_6, a "heavy axion" associated with sextet quark electroweak symmetry breaking, may have been seen at LEP via its two-photon decay mode and also at TRISTAN via its hadronic decay modes.

6917 (ANL/PHY/CP–77536) **Measurement of the cross-section ratio σ_n/σ_p in inelastic muon-nucleon scattering at very low x and Q^2.** Papavassiliou, V. Fermilab E-665 Collaboration. Argonne National Lab., IL (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-920837–15: ICHEP-26: 26th International Union of Pure and Applied Physics (IUPAP) conference on high energy physics, Dallas, TX (United States), 6-12 Aug 1992). Order Number DE93002916. Source: OSTI; NTIS; INIS; GPO Dep.

Preliminary results are presented on the measurement of the cross-section ratio σ_n/σ_p inelastic μN scattering obtained by the E-665 experiment using the Fermilab 490 GeV/c muon beam and liquid H_2 and D_2 targets. The results extend the previously measured x range by two orders of magnitude, down to 2×10^{-5}, at $Q^2 > 10^{-2}$ GeV^2/C^2. The ratio is consistent with 1 throughout the new range.

6918 (BNL–48087) **The Brookhaven rare kaon decay program.** Littenberg, L.S. Brookhaven National Lab., Upton, NY (United States). [1991]. 32p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9112111–2: KEK workshop on rare kaon decay physics, Tsukuba (Japan), 10-11 Dec 1991). Order Number DE93002952. Source: OSTI; NTIS; INIS; GPO Dep.

The results of the current generation of rare kaon decay experiments at Brookhaven National Laboratory are reviewed. The present status of and future plans for such experiments are discussed.

6919 (CONF-920777–2) **Physics from photon and lepton-pair spectra.** Young, G.R. Oak Ridge National Lab., TN (United States). Oct 1992. 39p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From NATO advanced study institute on particle production in highly excited matter; Ciocco (Italy); 12-25 Jul 1992. Order Number DE93003083. Source: OSTI; NTIS; INIS; GPO Dep.

A discussion is given of lepton-pair and direct photon spectra observed in hadron-hadron reactions at center-of-mass energies of 5–10 GeV and higher. Examples are taken from the high-energy p - A literature. The usefulness of lepton-pairs and photons for probing the space-time development of heavy-ion reactions is noted. A brief review of such measurements as they exist presently for heavy-ion reactions is also give, together with some notes for the interested experimentalist.

6920 (CONF-9209279–1) **Quark born diagrams: Meson-meson scattering amplitudes from the nonrelativistic quark potential model.** Barnes, T. (Oak Ridge National Lab., TN (United States)). Oak Ridge National Lab., TN (United States). [1992]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. (ORNL-CCIP–92-14). From 11. international seminar on high energy physics problems; Dubna (Russian Federation); 7-12 Sep 1992. Order Number DE93004158. Source: OSTI; NTIS; INIS; GPO Dep.

In this talk I summarize recent calculations of meson-meson scattering amplitudes in the nonrelativistic quark potential model, which assume that the scattering mechanism is one-gluon-exchange followed by constituent exchange (OGE+CEX). We refer to the scattering diagrams as "quark Born diagrams". For the cases chosen to isolate this mechanism, I=2 $\pi\pi$ and I=3/2 Kπ, the theoretical results are in remarkably good agreement with experimental S- and P-wave phase shifts and PCAC scattering lengths, given standard potential-model parameters.

6921 (DESY–92-107) **Joint angular decay distributions in exclusive weak decays of heavy mesons and baryons.** Bialas, P. (Jagellonian Univ., Cracow (Poland). Inst. of Physics); Koerner, J.G.; Kraemer, M.; Zalewski, K. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). Jul 1992. 45p. Contract BMFT 06MZ760;Grant KBN 2033809101. Order Number DE93742722. Source: OSTI; NTIS (US Sales Only); INIS.

We present the results of a comprehensive analysis of the angular decay distribution occuring in the weak exclusive decays of the lowest lying charm and bottom mesons and baryons. We deal with both semileptonic and nonleptonic decays and discuss various decay channels and their subsequent cascade decay chains including lepton mass effects. In the case of baryons we include polarization effects for the parent charm or bottom baryon. We list in table

forms general formulae which allow one to write down the joint angular decay distributions for the cascade decays $A \rightarrow B (\rightarrow b_1 + ... + b_n) + C(\rightarrow c_1 + ... + c_{n'})$ for all spin cases $s_A \leq 1/2$ and s_B, $s_C \leq 3/2$ for the prominent decays of B and C. Two examples involving meson and baryon decays are discussed in detail. (orig.).

6922 (DESY–92-114) **Unitarity corrections to the Lipatov pomeron and the small-x region in deep inelastic scattering in QCD.** Bartels, J. (Hamburg Univ. (Germany). 2. Inst. fuer Theoretische Physik). Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). Aug 1992. 18p. Order Number DE93742851. Source: OSTI; NTIS (US Sales Only); INIS.

We present the first corrections to the BFKL Pomeron and discuss some of their properties, in particular their application to the small-x region of deep inelastic scattering. We find evidence that the fan-diagrams of the Gribov-Levin-Ryskin equation are not the most dominant ones. (orig.).

6923 (DESY–92-116) **Excited fermions at e^+e^- and eP colliders.** Boudjema, F. (ENSLAPP, 74 - Annecy-le-Vieux (France). Lab. de Physique Theorique); Kneur, J.L.; Djouadi, A. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). Aug 1992. 61p. (ENSLAPP-A–385/92). Order Number DE93742853. Source: OSTI; NTIS (US Sales Only); INIS.

We analyse the discovery potentials of future colliders with respect to excited fermions which are expected in models of fermionic substructure. After discussing the possibilities offered by LEP, we will consider in detail the Next Linear Collider in its e^+e^-, $e\gamma$ and $\gamma\gamma$ modes [where the high-energy photon beams are obtained through back-scattering of laser light]. In addition, since eP colliders are well adapted to the search of the first generation of excited leptons, we include a study of their possible manifestation at HERA and LEP/LHC. We give complete and compact formulae for decay widths, production cross sections and angular distributions. Furthermore, we analyse in some detail the polarisation of the produced excited fermions which allows for an easy reconstruction of the correlations between the initial state and the decay products of the heavy fermions. (orig.).

6924 (DESY–92-122) **Parton density at small x_B.** Levin, E.M. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany)). Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). Sep 1992. 27p. (CONF-9206302–: Workshop on quantum chromodynamics (QCD) - 20 years later, Aachen (Germany), 9-13 Jun 1992). Order Number DE93742849. Source: OSTI; NTIS (US Sales Only); INIS.

This is a status report on new phenomena that are anticipated in deeply inelastic scattering in the low x region. I am viewing on this talk as summary of the theoretical situation in the region of small x, as is just before this new area of physics will be studied experimentally at HERA. (orig.).

6925 (DOE/ER/40150–197) **The N* program at CEBAF.** Burkert, V.D. CLAS N* collaboration. Continuous Electron Beam Accelerator Facility, Newport News, VA (United States). [1992]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84ER40150. (CEBAF-PR–92-021;CONF-920637–7: International conference on the structure of baryons and related mesons, New Haven, CT (United States), 1-4 Jun 1992). Order Number DE93000829. Source: OSTI; NTIS; INIS; GPO Dep.

A brief summary of the experimental program at CEBAF to study electro-magnetic transitions of nucleon resonances is given. The need for complete data sets, including measurements of polarization observables is stressed. It is emphasized that insight into fundamental properties of hadronic matter can be obtained by studying the Q^2 evolution of resonance transition amplitudes and their comparison with microscopic models of baryons.

6926 (DOE/ER/40364–T1) **Nuclear studies with intermediate energy probes: Annual performance report.** Norum, B.E. Virginia Univ., Charlottesville, VA (United States). Dept. of Physics. 10 Jul 1992. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-87ER40364. Order Number DE93002785. Source: OSTI; NTIS; INIS; GPO Dep.

Data from measurements at NIKHEF-K of the electro-production of neutral pions from the proton were completely analyzed and axe about to be submitted for publication. These results represent the first precise measurement of this fundamental process in the threshold region. The results are completely consistent with calculations based upon the Low Energy Theorems. Results from studies of a gas jet target in the electron storage ring of the Saskatchewan Accelerator Laboratory (SAL) have been fully analyzed and are being prepared for publication. An Internal Target Development Facility (ITDF), established at NIKHEF-K in a collaborative effort for the purpose of developing higher density gas jet targets suitable for use in electron rings, is operational. Diagnostic techniques are being evaluated in preparation for evaluating jet technology options. Our study of the calcium isotopes (^{42}C and ^{44}C) is nearing completion. Both the electron and proton scattering data have been completely analyzed. Consistent proton and neutron transition densities have been extracted, and are being compared to corresponding results from pion scattering. Preparations for (γ,π^-) measurements at SAL have been completed, and data taking is about to commence.

6927 (FNAL/C–92/252-E) **Inclusive J/ψ, ψ (2S) and b-quark production in $\bar{p}p$ collisions at $\sqrt{s}$ = 1.8 TeV.** Papadimitriou, V. CDF Collaboration. Fermi National Accelerator Lab., Batavia, IL (United States). Nov 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-920837–36: ICHEP-26: 26th International Union of Pure and Applied Physics (IUPAP) conference on high energy physics, Dallas, TX (United States), 6-12 Aug 1992). Order Number DE93004739. Source: OSTI; NTIS; INIS; GPO Dep.

Inclusive J/ψ and $\psi(2S)$ production has been studied in $p\bar{p}$ collisions at $\sqrt{s}$ = 1.8 TeV with the Collider Detector at Fermilab. The products of production cross section times the branching fraction of $J/\psi(\psi(2S))$ to $\mu^+\mu^-$ are reported as functions of the $J/\psi(\psi(2S))$ P_T in the kinematic range $P_T > 6$ GeV/c and $|\eta| \leq 0.5$. The products of the integrated cross section times branching fraction and the b-quark production cross section calculated from these values are also reported.

6928 (FNAL/C–92/262) **Multi-jet production rates in deep-inelastic muon-proton scattering.** Salgado, C.W. E665 Collaboration. Fermi National Accelerator Lab., Batavia, IL (United States). Oct 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-920837–25: ICHEP-26: 26th International Union of Pure and Applied Physics (IUPAP) conference on high energy physics, Dallas, TX (United States), 6-12 Aug 1992). Order Number DE93004410. Source: OSTI; NTIS; INIS; GPO Dep.

Measurements of forward multi-jet production rates in deep-inelastic muonproton scattering are presented. Data were taken with a 490 GeV muon beam incident on a hydrogen target. Jets were defined using the JADE jet finding algorithm. The measured rates are presented as function of W, the hadronic center-of-mass energy and the jet resolution parameter, y_{cut}, in energies up to W=33 GeV. Good agreement is found in comparisons with predictions of the QCD-inspired Lund Monte Carlo models. Non-perturbative QCD production mechanisms, inside the Lund Model, can not reproduce the results for energies greater than $W \simeq 20$ GeV. Sensitivities of the jet rate measurements to the low x ($x \simeq 0.02$) gluon content of the nucleon and the evolution of α_s, are studied.

6929 (FNAL/C–92/287-E) **Search for exotic particles at CDF.** Gold, M.S. The CDF Collaboration. Fermi National Accelerator Lab., Batavia, IL (United States). Oct 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-920837–35: ICHEP-26: 26th International Union of Pure and Applied Physics (IUPAP) conference on high energy physics, Dallas, TX (United States), 6-12 Aug 1992). Order Number DE93004421. Source: OSTI; NTIS; INIS; GPO Dep.

We have searched for exotic particles in $p\bar{p}$ collisions at 1.8 TeV in data taken with the Collider Detector at Fermilab. We review our published limits on W′ and Z′ masses, and on the scale of lepton-quark compositeness. We also report preliminary mass limits based on searches for leptoquarks, supersymmetric quarks and gluons, and exotic, stable colored fermions.

6930 (FNAL/C–92/302) **First W decays observed with the D0 detector.** Gobbi, B. (Northwestern Univ., Evanston, IL (United States). Dept. of Physics and Astronomy). D0 Collaboration. Fermi National Accelerator Lab., Batavia, IL (United States). Oct 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-920837–32: ICHEP-26: 26th International Union of Pure and Applied Physics (IUPAP) conference on high energy physics, Dallas, TX (United States), 6-12 Aug 1992). Order Number DE93004742. Source: OSTI; NTIS; INIS; GPO Dep.

We have observed the first few W decays into electrons at the Tevatron, using the newly commissioned D0 detector. Preliminary results are presented. The number of observed decays as well as the transverse momentum of the electron, the neutrino and their transverse mass distributions, are consistent with expectations.

6931 (IFT-P–022/92) **Comment on the τ decay puzzle.** Escobar, C.O. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica); Pers, O.L.G.; Pleitez, V.; Funchal, R.Z. Instituto de Fisica Teorica (IFT), Sao Paulo, SP (Brazil). Jul 1992. [9] Order Number DE93609973. Source: OSTI; NTIS (US Sales Only); INIS.

We analyze the current data on τ-lepton decays and show that they are consistent with the Standard Model. (author).

6932 (IFT-P–023/92) **Three generations mixing and τ decay puzzle.** Escobar, C.O. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica); Peres, O.L.G.; Pleitez, V. Instituto de Fisica Teorica (IFT), Sao Paulo, SP (Brazil). Jul 1992. [10] Order Number DE93609974. Source: OSTI; NTIS (US Sales Only); INIS.

We consider the possibility that the τ decay puzzle is a consequence of the Kobayashi-Maskawa mixing in the leptonic sector. (author).

6933 (INS–933) **Borel sum rules for octet baryons in nuclear medium.** Kondo, Y.; Morimatsu, O. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Jun 1992. 13p. Order Number DE93753245. Source: OSTI; NTIS; INIS.

Borel sum rules are examined for octet baryons in the nuclear medium. First, it is noticed that in the medium the dispersion relation is realized for the retarded correlation $\Pi^R(\omega, q^2)$ in the energy ω. Then, $\Pi^R(\omega, q^2)$ is split into even and odd parts of ω in order to apply the Borel transformation. The obtained Borel sum rules differ from those of previous works. The mass shifts of octet baryons are calculated in the leading order of the operator product expansion with linear density approximation for the condensates. It is found that both scalar and vector condensates of the quark field, <q-barq> and <q*q>, induce attraction to the octet baryons in the medium in contrast to the results of previous works. It is also found that $-\delta M_N- > -\delta M_\Lambda- > -\delta M_\Sigma- \approx -\delta M_\Xi-$. The absolute values, however, turn out to be one order of magnitude larger than those empirically known if a Borel mass of around 1 GeV is used in the present approximation. (author).

6934 (INS–934) **Study of the rare decays $K_L^0 \to \mu e$, $K_L^0 \to ee$, and $K_L^0 \to \mu\mu$.** Komatsubara, T.K. (Tokyo Univ. (Japan). Dept. of Physics). Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Jun 1992. 5p. Order Number DE93753247. Source: OSTI; NTIS; INIS.

An experimental study of the rare decays $K_L^0 \to \mu e$, $K_L^0 \to ee$, and $K_L^0 \to \mu\mu$ was performed at the KEK 12-GeV Proton Synchrotron. No event was observed in the fiducial region for the decay $K_L^0 \to \mu e$. There was one event in the fiducial region for the decay $K_L^0 \to ee$, which was indistinguishable from the background. Normalizing to the decay $K_L^0 \to \pi^+\pi^-$, the upper limits on the branching ratios at 90% confidence level were $B(K_L^0 \to \mu e) < 9.4 \times 10^{-11}$ and $B(K_L^0 \to ee) < 1.6 \times 10^{-10}$. We observed 179 $K_L^0 \to \mu\mu$ events in the fiducial region, and the branching ratio $B(K_L^0 \to \mu\mu) = [7.9 \pm 0.6(\text{stat}) \pm 0.3(\text{syst})] \times 10^{-9}$ was obtained. (author).

6935 (JINR–7-46-90, pp. 6-18) **An experiment to search for cumulative muon pairs with low invariant mass.** Afanas'ev, S.V. (Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of High Energy); Anisimov, Yu.S.; Bazylev, S.N. Joint Inst. for Nuclear Research, Dubna (Russian Federation). 1990. In *JINR rapid communications: Collection.* [77] Order Number DE93609511. Source: OSTI; NTIS (US Sales Only); INIS.

Muon pair production with small invariant mass has been observed beyond the nucleon-nucleon kinematic limit. The obtained value of cross section does not contradict a universal picture of the cumulative effect. 13 refs.; 6 figs.; 1 tab.

6936 (KFTI–90-3) **Non-uniformity of impulse approximation for photoproduction of neutral pions on deuterons.** Stoletnij, I.V.; Rekalo, M.P. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. [29] (In Russian). Order Number DE93609960. Source: OSTI; NTIS (US Sales Only); INIS.

In flames of nonrelativistic impulse approximation spin structure of amplitude of elastic photoproduction of neutral pions on deuterons, gammad->pi^{0}d is ascertained. It is shown that both $d\sigma/d\Omega$ and Ω absolute values and form of their energy dependence (at fixed values of tranferred impulse square or π^0-meson emission angle) much depend on the choice of Fermi impulse. 33 refs.; 7 figs.

6937 (LA-UR–92-3334) **Neutron-proton bremsstrahlung experiments.** Koster, J.E. (Los Alamos National Lab., NM (United States)); Nelson, R.O.; Schillaci, M.E.; Wender, S.A.; Mayo, D.; Brady, F.P.; Romero, J.; Krofcheck, D.; Blann, M.; Anthony, P.; Brown, V.R.; Hansen, L.; Pohl, B.; Sangster, T.C.; Nifenecker, H.; Pinston,.Los Alamos National Lab., NM (United States). [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-921116–16: 12. international conference on the application of accelerators in research and industry, Denton, TX (United States), 2-5 Nov 1992). Order Number DE93003737. Source: OSTI; NTIS; GPO Dep.

It is well known that charged particles emit bremsstrahlung radiation when they are accelerated. Classical electron bremsstrahlung occurs when a photon is emitted by an electron accelerated in the field of a nucleus. The bremsstrahlung process also occurs in the scattering of nucleons, for which it is the lowest energy inelastic process that can occur. Like electron bremsstrahlung, nucleon-nucleon bremsstrahlung also requires the exchange of a virtual particle to conserve energy and momentum. In electron bremsstrahlung a virtual photon is exchanged but with two nucleons a meson can be exchanged. Unlike electron bremsstrahlung, in nucleon-nucleon bremsstrahlung the photon can originate from the exchanged meson. This exchange contribution has been shown in calculations to be a significant fraction of bremsstrahlung events. Thus bremsstrahlung serves as a probe of exchange currents in the nucleon-nucleon interaction. Because of a lack of a free neutron target or an intense neutron beam, few measurements of neutron-proton bremsstrahlung exist, each having poor statistical accuracy and poor energy resolution. The white neutron source at the Weapons Neutron Research (WNR) target area at the Los Alamos Meson Physics Facility (LAMPF) produces neutrons with energies from below 50 to above 400 MeV. Using time-of-flight techniques and a liquid hydrogen target, we are measuring the outgoing photons of energies up to 250 MeV at gamma ray angles of around 90° relative to the incident beam. Protons scattered at very forward angles are also detected in coincidence with the gamma rays.

6938 (LA-UR–92-3489) **Preliminary results from Fermilab E789.** Peng, J.C. (Los Alamos National Lab., NM (United States)); Boissevain, J.; Carey, T.A.; Jansen, D.M.; Jeppesen, R.; Kapustinsky, J.S.; Lane, D.W.; Leitch, M.J.; Lillberg, J.W.; McGaughey, P.L.; Moss, J.M.; Brown, G.; Isenhower, D.; Sadler, M.; Schnathorst,Los Alamos National Lab., NM (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36 ;AC02-76CH03000. (FNAL/C–92/301;CONF-920837–22: ICHEP-26: 26th International Union of Pure and Applied Physics (IUPAP) conference on high energy physics, Dallas, TX (United States), 6-12 Aug 1992). Order Number DE93003752. Source: OSTI; NTIS; INIS; GPO Dep.

Fermilab experiment 789 studies low-multiplicity decays of neutral D and B mesons in a high-rate fixed-target environment. Preliminary results from the 1991 run are presented.

6939 (LA-UR–92-3614) **Results from the Soviet-American gallium experiment.** Anosov, O.L. (AN SSSR, Moscow (Russian Federation). Inst. Yadernykh Issledovanij); Faizov, E.L.; Gavrin, V.N.; Kalikhov, A.V.; Knodel, T.V.; Knyshenko, I.I.; Kornoukhov, V.N.; Mirmov, I.N.; Ostrinsky, A.V.; Pshukov, A.M.; Shikhin, A.A.; Timofeyev, P.V.; VeLos Alamos National Lab., NM (United States).

[1992]. 6p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States); AN SSSR, Moscow (Russian Federation); Ministry of Sciences (Russian Federation). DOE Contract W-7405-ENG-36. (CONF-9206227–5: 15. international conference on neutrino physics, Granada (Spain), 7-13 Jun 1992). Order Number DE93003798. Source: OSTI; NTIS; INIS; GPO Dep.

A radiochemical ^{71}Ga–^{71}Ge experiment to determine the primary flux of neutrinos from the Sun began measurements of the solar neutrino flux at the Baksan Neutrino Observatory in 1990. The number of ^{71}Ge atoms extracted from 30 tons of gallium in 1990 and 57 tons in 1991 was measured in twelve runs during the period of January 1990 to December 1991. For the 1990 data, we observed the capture rate to be 20 + 15/−20 (stat) ±32 (syst) SNU, resulting in a limit of less than 79 SNU (90% CL). This is to be compared with 132 SNU predicted by the Standard Solar Model. The 1991 data, taken with 57 tons of gallium, shows a non zero ^{71}Ge signal. A final result from the 1990 and 1991 data is still pending completion of studies of possible systematic effects.

6940 (LA-UR–92-3719) **Latest results from the Soviet-American gallium experiment.** Gavrin, V.N. (AN SSSR, Moscow (Russian Federation). Inst. Yadernykh Issledovanij); Anosov, O.L.; Faizov, E.L.; Kalikhov, A.V.; Knodel, T.V.; Knyshenko, I.I.; Kornoukhov, V.N.; Mirmov, I.N.; Ostrinsky, A.V.; Pshukov, A.M.; Shikhin, A.A.; Timofeyev, P.V.; VeLos Alamos National Lab., NM (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States); AN SSSR, Moscow (Russian Federation); Ministry of Sciences (Russian Federation). DOE Contract W-7405-ENG-36. (CONF-920837–23: ICHEP-26: 26th International Union of Pure and Applied Physics (IUPAP) conference on high energy physics, Dallas, TX (United States), 6-12 Aug 1992). Order Number DE93003821. Source: OSTI; NTIS; INIS; GPO Dep.

A radiochemical ^{71}Ga-^{71}Ge experiment to determine the primary flux of neutrinos from the Sun began measurements of the solar neutrino flux at the Baksan Neutrino Observatory in 1990. The number of ^{71}Ge atoms extracted from 30 tons of gallium in 1990 and from 57 tons of gallium in 1991 was measured in twelve runs during the period of January 1990 to December 1991. The combined 1990 and 1991 data sets give a value of 58 +17/−24 (stat) ± 14 (syst) SNU. This is to be compared with 132 SNU predicted by the Standard Solar Model.

6941 (LA-UR–92-3788) **Do scattering effects resolve the 17-keV conundrum?.** Hime, A. Los Alamos National Lab., NM (United States). [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-921122–7: Meeting of the Division of Particles and Fields of the American Physics Society, Batavia, IL (United States), 10-14 Nov 1992). Order Number DE93003838. Source: OSTI; NTIS; INIS; GPO Dep.

Recent developments in pursuance of the 17-keV neutrino are summarized. While electron scattering effects are a likely culprit for the anomalies observed in β decay measurements at Oxford, missing links remain. Further experimental efforts are required to clarify the issue.

6942 (LA-UR–92-3807) **Rare decays.** Herczeg, P. Los Alamos National Lab., NM (United States). [1992]. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-920682–2: International symposium on weak and electromagnetic interactions in nuclei, Dubna (Russian Federation), 16-22 Jun 1992). Order Number DE93003843. Source: OSTI; NTIS; INIS; GPO Dep.

We review and discuss two areas in the field of rare decays: the rare decays of the charged pion, and the lepton family number violating decays of the muon and the kaons.

6943 (LA-UR–92-3857) **Meson form-factors and wave-functions with Wilson fermions.** Gupta, R.; Daniel, D.; Grandy, J. Los Alamos National Lab., NM (United States). [1992]. 4p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9209276–2: LATTICE '92: lattice field theory, Amsterdam (Netherlands), 15-19 Sep 1992). Order Number DE93003859. Source: OSTI; NTIS; INIS; GPO Dep.

Results for semi-leptonic form-factors for the process D → Klν and the Bethe-Salpeter amplitudes (BSA) for pion and (rho) mesons are presented. The form-factor data is consistent with previous calculations. We find that the long distance fall-off of BSA for both π and ρ is very well fit by an exponential, but surprisingly the effective mass governing this fall-off is lighter than the pion's. Lastly, by studying the dependence of ρ polarization on, separation direction we show that there is a measurable 1 = 2 state in addition to 1 = 0 in the BSA for the rho.

6944 (MPI-PhE–92-03) **Determination of the Parton distributions in the proton by means of the neutrino and antineutrino scattering on hydrogen and deuterium.** Katz, U.F. Max-Planck-Institut fuer Physik, Muenchen (Germany). Werner-Heisenberg-Institut; Technische Univ. Muenchen, Garching (Germany). Fakultaet fuer Physik. May 1992. 151p. (In German). Order Number DE93744563. Source: OSTI; NTIS (US Sales Only); INIS.

Studied are in this thesis deep inelastic reactions of muonic neutrinos and antineutrinos with protons and deuterons via the weak charged current. Aim of the analysis is the determination of the parton distributions in the proton as well as the structure functions for the (anti)neutrino scattering. Special weight is thereby assigned to the measurement of the ratio $r_v(x)$ of the d and u valence quark distributions. (orig.).

6945 (SLAC-PUB–5926) **Spectroscopy of the D-wave $q\bar{q}$ system; evidence for two $J^P = 2^-$ strange meson states decaying to $K^-\omega$.** Ratcliff, B.N. (Stanford Linear Accelerator Center, Menlo Park, CA (United States)); Aston, D.; Bienz, T.; Bird, F.; Dunwoodie, W.; Johnson, W.B.; Kunz, P.; Kwon, Y.; Leith, D.W.G.S.; Levinson, L.; Rensing, P.; Schultz, D.; Shapiro, S.; Sinervo, P.K.; TogeStanford Linear Accelerator Center, Menlo Park, CA (United States). Sep 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. Grant PHY82-09144;Grant PHY85-13808. (CONF-920837–14: ICHEP-26: 26th International Union of Pure and Applied Physics (IUPAP) conference on high energy physics, Dallas, TX (United States), 6-12 Aug 1992). Order Number DE93004008. Source: OSTI; NTIS; INIS; GPO Dep.

Evidence is presented for two $J^P = 2^-$ strange mesons; one at $\approx$ 1.77 and the other at $\approx$ 1.82 GeV/c^2. These states have been observed in a partial wave analysis of the $K^-\omega$ system in the reaction $K^-p \rightarrow K^-\pi^+\pi^-\pi^0 p$ where the strange mesons decay into $K^-\omega$ and the ω then decays to $\pi^+\pi^-\pi^0$. The data set contains $\approx 10^5$ $K^-\omega p$ events at 11 GeV/c taken with the LASS spectrometer at SLAC.

6946 (SLAC-PUB–5969) **An experimental test of the LPM effect: Bremsstrahlung suppression at high energies.** Klein, S. (California Univ., Santa Cruz, CA (United States). Inst. for Particle Physics); Cavalli-Sforza, M.; Kelley, L.; Anthony, P.; Dietrich, F.; Vanbibber, K.; Becker-Szendy, R.; Gearhart, R.; Niemi, G.; Perl, M.; Rochester, L.; Bosted, P. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Nov 1992. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (SCIPP–92/44;CONF-921122–3: Meeting of the Division of Particles and Fields of the American Physics Society, Batavia, IL (United States), 10-14 Nov 1992). Order Number DE93004019. Source: OSTI; NTIS; INIS; GPO Dep.

We are preparing an experiment at SLAC to test the LPM (Landau-Pomeranchuk-Migda) effect. In bremsstrahlung from high energy electrons, the longitudinal momentum transferred from the nucleus is very small. Then, by the uncertainty principle, the interaction must occur over a distance much larger than the atomic scale. In the LPM effect, multiple scattering changes the electron trajectory within the interaction distance, and so suppresses the bremsstrahlung. This effect, predicted in the 1950's, has never been quantitatively studied. For dense, high Z, targets in a 25 GeV electron beam, suppression is significant for photons below a few hundred MeV. By comparing bremsstrahlung from targets of different (Pb, U, W and C), it is possible to measure the suppression accurately. We will also study the longitudinal density effect, where very low energy photon emission is suppressed due to the dielectric effect of the medium.

6947 (SLAC-PUB–5973) **QCD studies of hadronic decays of Z^0 bosons by SLD.** Muller, D. SLD Collaboration. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Nov 1992. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-920837–17: ICHEP-26: 26th International Union of Pure and Applied Physics (IUPAP) conference on high energy physics, Dallas, TX (United States), 6-12 Aug 1992). Order Number DE93004020. Source: OSTI; NTIS; INIS; GPO Dep.

Z^0 bosons have been produced by collisions of longitudinally polarized electrons with unpolarized positrons at the SLAC Linear Collider and their decays have been recorded by the SLD experiment. We present preliminary QCD results based on the first 6000 such decays. We find good agreement between the inclusive properties of these data and the predictions of perturbative QCD plus fragmentation models. The strong coupling, α_s, has been measured by three methods: jet rates yield $\alpha_s(M_Z) = 0.119 \pm 0.002$ (stat.) $\pm$ 0.003 (exp.syst.) $\pm$ 0.014 (theor); energy-energy correlations yield $\alpha_s(M_Z) = 0.121 \pm 0.002 \pm 0.004 \pm {}^{0.0016}_{0.009}$; the energy-energy correlation asymmetry gives $\alpha_s(M_Z) = 0.108 \pm 0.003 \pm 0.005 \pm {}^{0.008}_{0.003}$.

6948 (SLAC-PUB–5997) **Jet inclusive cross sections.** Del Duca, V. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Nov 1992. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-921122–4: Meeting of the Division of Particles and Fields of the American Physics Society, Batavia, IL (United States), 10-14 Nov 1992). Order Number DE93004272. Source: OSTI; NTIS; INIS; GPO Dep.

Minijet production in jet inclusive cross sections at hadron colliders, with large rapidity intervals between the tagged jets, is evaluated by using the BFKL pomeron. We describe the jet inclusive cross section for an arbitrary number of tagged jets, and show that it behaves like a system of coupled pomerons.

6949 (UM-P–91/112) **Constraints on CP violating nucleon-nucleon interactions in gauge models from atomic electric dipole moment.** He, Xiaogang; McKellar, B.H.J. Melbourne Univ., Parkville, VIC (Australia). School of Physics. [1992]. [28] Sponsored by Australian Research Council, Canberra, ACT (Australia). (OZ–91/22.). Order Number DE93609963. Source: OSTI; NTIS (US Sales Only); INIS.

In this paper CP violating nucleon-nucleon interactions are studied in several models. The experimental upper bounds on atomic electric dipole moment (EDM) are used to constrain CP violating parameters. The constraints from this consideration were compared with that obtained from the upper bound on the neutron EDM. It was found that although the constraints from the former consideration are not yet as sensitive as the latter, in some models the constraints from both considerations are within an order of magnitude. 45 refs., 1 fig.

6624 Properties of Specific Particles and Resonances

Refer also to citation(s) 6391, 6863, 6908, 6912, 6914, 6935

6950 (ANL-HEP-CP–92-124) **Interactions of atmospheric ν_μ and ν_e observed in Soudan 2.** Goodman, M. Soudan 2 Collaboration. Argonne National Lab., IL (United States). High Energy Physics Div. [1992]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-921122–12: Meeting of the Division of Particles and Fields of the American Physics Society, Batavia, IL (United States), 10-14 Nov 1992). Order Number DE93005568. Source: OSTI; NTIS; INIS; GPO Dep.

We present preliminary measurements of the relative rates of atmospheric ν_μ and ν_e interactions from the first 0.5 kton-year exposure of the Soudan 2 experiment. The results are consistent with deficit of ν_μ relative to ν_e reported by the water Cerenkov experiments, which may be evidence for neutrino oscillations.

6951 (DOE/ER/40448–5) **Theoretical aspects of electroweak and other interactions in medium energy physics: interim progress report, November 20, 1992.** Mukhopadhyay, N.C. Rensselaer Polytechnic Inst., Troy, NY (United States). Dept. of Physics. [1992]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER40448. Order Number DE93003714. Source: OSTI; NTIS; INIS; GPO Dep.

Progress in the study of electroweak structure of baryon resonances and in the analysis of data for pion and eta photoproduction. Four graduate students are currently associated with the program. One has obtained his Ph.D. degree in the year under review. Six research articles have been completed in this year, and five conference contributions have been made. Collaborations with scientists from Illinois, Los Alamos, Westinghouse, William and Mary, Yale, Mainz (Germany), Saskatchewan (Canada) and TRI-UMF (Canada) continue, along with participation in collaborations at CEBAF.

6952 (DOE/ER/40621–2) **Collider Physics: SDC/SSC liquified fiber calorimetry: Progress report, 1992.** White, J.T.; Huson, F.R. Texas A and M Univ., College Station, TX (United States). Dept. of Physics. [1992]. 69p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-91ER40621. Order Number DE93005116. Source: OSTI; NTIS; INIS; GPO Dep.

Most effort was directed toward the D-Zero experiment at Fermilab. Over 3 pb^{-1} of high-quality physics data have been obtained. Analysis of the results (wino-zino physics, squark physics), D-zero data acquisition systems efforts, and level-1 and level-2 trigger work are described. Other work concerned detector development for use at the SSC. This technology consists of using liquid scintillator-filled tubes as scintillating fibers for a "calorimeter." The key issues were to demonstrate that the liquid fibers were sufficiently rad-hard and to demonstrate that fibers with sufficiently long attenuation length could be found to satisfy the resolution requirements; both constraints could be satisfied.

6953 (FNAL/C–92/297-E) **CDF measurements of the W mass and search for the top.** Leone, S. (Istituto Nazionale di Fisica Nucleare, Pisa (Italy)). CDF Collaboration. Fermi National Accelerator Lab., Batavia, IL (United States). Oct 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-9206227–6: 15. international conference on neutrino physics, Granada (Spain), 7-13 Jun 1992). Order Number DE93004740. Source: OSTI; NTIS; INIS; GPO Dep.

The derivation of the W mass value of 79.91 $\pm$ 0.39 GeV/c^2 is discussed. The present limit at 91 GeV/c^2 (95% C.L.) on the mass of the top quark is also presented. In the next two years of data collection, we expect to collect significantly more luminosity than in the past. We discuss prospects for the discovery of the top quark and improvements of the current measurements.

6954 (JAERI-M–92-085) **Experiment and analysis on elastic deformation properties of graphite and carbon materials for HTTR core components.** Arai, Taketoshi (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Minato, Kazuo; Eto, Motokuni; Oku, Tatsuo; Yoda, Shinichi. Japan Atomic Energy Research Inst., Tokyo (Japan). Jun 1992. 33p. (In Japanese). Order Number DE93753271. Source: OSTI; NTIS; INIS.

Fine-grained isotropic graphite grade IG-110, medium-grained near-isotropic graphite grade PGX and coarse-grained baked carbon grade ASR-ORB are employed as structural materials for the High Temperature Engineering Test Reactor (HTTR). The material properties for design are specified in Structural Design Code for Graphite Components of HTTR. This report describes in detail the experiment on deformation behavior including stress-strain relationship, elastic modulas and Poisson's ratio of each grade. An analytical method for linear elastic approximation leads to the property values contained in the Code. (author).

6955 (LA-UR–92-3956) **Direct searches for neutrino mass.** Wilkerson, J.F. Los Alamos National Lab., NM (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9206227–4: 15. international conference on neutrino physics, Granada (Spain), 7-13 Jun 1992). Order Number DE93003867. Source: OSTI; NTIS; GPO Dep.

At present there is no positive experimental evidence that neutrinos have mass. Nevertheless, searches for neutrino mass continue, largely because the consequences of neutrinos having

mass would be quite profound. In particular, the discovery of a non-zero neutrino mass would be a clear indication of physics beyond the current particle-physics standard model. In addition, neutrinos, if they have mass, remain viable candidates for the non-baryonic dark matter known to permeate galaxies. The current status of the experimental efforts searching for neutrino mass will be reviewed. In particular, it will be shown that the most recent tritium beta decay searches for neutrino mass clearly rule out the non.zero neutrino mass result first reported in 1980 by the Institute for Theoretical and Experimental Physics (ITEP) in Moscow. However, a troubling feature of these same recent results is that they all have best fits to neutrino mass squared that are negative. The significance of these negative neutrino mass squared results will be explored.

6956 (LBL–32953) **A massive neutrino in nuclear beta decay?.** Norman, E.B. (Lawrence Berkeley Lab., CA (United States)); Chan, Yuen-Dat; Garcia, A.; Lesko, K.T.; Larimer, R.M.; Stokstad, R.G.; Sur, B.; Zlimen, I.; da Cruz, M.T.F.; Hindi, M.M.; Wietfeldt, F.E. Lawrence Berkeley Lab., CA (United States). Aug 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-920837–30: ICHEP-26: 26th International Union of Pure and Applied Physics (IUPAP) conference on high energy physics, Dallas, TX (United States), 6-12 Aug 1992). Order Number DE93004718. Source: OSTI; NTIS; INIS; GPO Dep.

We have continued our studies of the p-spectrum of ^{14}C using a germanium detector doped with ^{14}C. There is a feature in the β-spectrum 17 keV below the endpoint which could be explained by the hypothesis that there is a heavy neutrino emitted in the β-decay of ^{14}C with a mass of 17±1 keV and an emission probability of 1.26±0.25%. However, we also have performed a high statistics measurement of the inner bremsstrahlung spectrum of ^{55}Fe and find no indication of the emission of a 17-keV neutrino. We conclude that the origin of the "kink" that has been observed in some recent beta spectral measurements is not a neutrino.

6957 (SLAC-PUB–5937) **The discovery of the tau lepton.** Perl, M.L. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Sep 1992. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-9206131–3: 3. international symposium on the history of particle physics - the rise of the standard model, Stanford, CA (United States), 24-27 Jun 1992). Order Number DE93004013. Source: OSTI; NTIS; INIS; GPO Dep.

The discovery of the tau lepton and the third generation of fermions came from the convergence of three physics streams in the late 1960's and early 1970's. These streams were: the failed attempts by myself and others to understand the connection between the electron and the muon, the development of electron-positron storage rings, and the development of the theory of sequential leptons. In this paper I give the history of the discovery of the tau and the measurement of its major properties-the properties which established the tau as a sequential lepton.

6958 (SLAC-PUB–5958) **Searches for massive neutrinos in nuclear beta decay.** Jaros, J.A: Stanford Linear Accelerator Center, Menlo Park, CA (United States). Oct 1992. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-9205274–2: Trieste workshop on the search for new elementary particles: particles, status and prospects, Trieste (Italy), 20-22 May 1992). Order Number DE93004271. Source: OSTI; NTIS; INIS; GPO Dep.

The status of searches for massive neutrinos in nuclear beta decay is reviewed. The claim by an ITEP group that the electron antineutrino mass > 17eV has been disputed by all the subsequent experiments. Current measurements of the tritium beta spectrum limit $m_{\bar{\nu}e} < 10$ eV. The status of the 17 keV neutrino is reviewed. The strong null results from INS Tokyo and Argonne, and deficiencies in the experiments which reported positive effects, make it unreasonable to ascribe the spectral distortions seen by Simpson, Hime, and others to a 17keV neutrino. Several new ideas on how to search for massive neutrinos in nuclear beta decay are discussed.

6959 (SLAC-PUB–6002) **Measurement of the tau lepton mass by the Beijing Spectrometer (BES) Collaboration.** Soderstrom, E. BES Collaboration. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Nov 1992. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-9207140–2: Stanford Linear Accelerator Center (SLAC) summer institute on particle accelerators: third family and the physics of flavor, Stanford, CA (United States), 13-24 Jul 1992). Order Number DE93004628. Source: OSTI; NTIS; INIS; GPO Dep.

The mass of the τ lepton has been measured at the Beijing Electron Positron Collider using the Beijing Spectrometer. A search near threshold for $e^+e^- \rightarrow \tau^+\tau^-$ was performed. Candidate events were identified by requiring that one τ decay via $\tau \rightarrow e\nu\bar{\nu}$, and the other via $\tau \rightarrow \mu\nu\bar{\nu}$. The mass value, obtained from a fit to the energy dependence of the $\tau^+\tau^-$ cross section, is $m_\tau = 1776.9_{-0.5}^{+0.4} \pm 0.2$ MeV.

6960 (UM-P–92/41) **Massive neutrinos.** Taylor, G.; Tovey, S. Melbourne Univ., Parkville, VIC (Australia). School of Physics. [1992]. [10] Order Number DE93609989. Source: OSTI; NTIS (US Sales Only); INIS.

Neutrinos have intrigues physicists for over 60 years, yet it still is not determined if they possess a mass. Spontaneous oscillations between the various types of neutrinos, in analogy with the observed flavour oscillations between quarks, would be irrefutable evidence for non-zero neutrino mass. A group of experimental physicists from Australia has joined a new experiment to search for neutrino oscillations and this article reviews the importance of searching for such phenomena. 4 refs., 4 figs.

6630 Nuclear Physics

Refer also to citation(s) 5730, 6281

6631 Nuclear Structure

Refer also to citation(s) 6980, 6986, 7000, 7017

6961 (BNL–48044) **Phenomenological correlations in nuclear structure: An opportunity for nuclear astrophysics and a challenge to theory.** Casten, R.F. (Brookhaven National Lab., Upton, NY (United States)); Zamfir, N.V. Brookhaven National Lab., Upton, NY (United States). [1992]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016 ;FG02-88ER40417. (CONF-9209239–2: Workshop on nuclear physics in the universe, Oak Ridge, TN (United States), 24-26 Sep 1992). Order Number DE93003470. Source: OSTI; NTIS; INIS; GPO Dep.

Though it often appears daunting in its complexity, nuclear data frequently exhibits remarkable simplicities when viewed from the appropriate perspectives. This realization, which is becoming more and more apparent, is one of the fruits of the vast amount of nuclear data that has been accumulated over many years but, surprisingly, has never been completely digested. This emerging, unified, and simple macroscopic phenomenology, aided by microscopic underpinnings and physical arguments, appears in many guises and often simplifies semi-empirical estimates of structure far from stability in the critical realms where nuclear astrophysics takes place and where it is in need for improved nuclear input. The generality of simple phenomenological relationships begs both for a sound theoretical basis and for the advent of Radioactive Nuclear Beams so that the reliability of their extrapolations can be assessed and tested. These issues will be discussed, and illustrated with a number of specific examples.

6962 (DOE/ER/40353–15) **Proton resonance spectroscopy: Progress report, December 1, 1991–November 30, 1992.** Shriner, J.F. Jr. Tennessee Technological Univ., Cookeville, TN (United States). Dept. of Physics. Nov 1992. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-87ER40353. Order Number DE93004377. Source: OSTI; NTIS; INIS; GPO Dep.

Preparations for studying ^{30}P via $^{29}Si(p,\gamma)$ have continued. We are exploring both the use of the Fourier transform and the statistical behavior of electromagnetic transition strengths within the shell model as alternate approaches to identifying quantum chaos in

nuclei. Analysis of interfering resonances in (p,α) resonances suggests that improvements in the limits on detailed balance in nuclear reactions are possible, but several issues still must be considered before a definitive conclusion can be reached. Plans for a new control system for the High Resolution Laboratory's electrostatic analyzer are being implemented.

6963 (DOE/ER/40608–2) **Brief biographical sketches of the research staff of the Nuclear Theory Group: FY1992.** Yale Univ., New Haven, CT (United States). [1992]. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER40608. Order Number DE93005941. Source: OSTI; NTIS; INIS; GPO Dep.

Brief summaries of past and planned activities in the following areas are given: models of nuclear structure; models of hadronic structure; hot nuclei; chaos in nuclei; reactions and structure; dissipation, diffusion, and collective motion; and modeling equilibrium and nonequilibrium systems.

6964 (DOE/ER/40609–2) **[Experimental nuclear physics].** Yale Univ., New Haven, CT (United States). [1992]. 51p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER40609. Order Number DE93004950. Source: OSTI; NTIS; INIS; GPO Dep.

An earlier study of unusual electromagnetic decays in ^{86}Zr was extended in order to make comparisons with its isotone ^{84}Sr and with ^{84}Zr. The K=14 ($t_{\frac{1}{2}}$ = 70 ns) high-spin isomer in ^{176}W was found to have a 13% branch directly to the K=O ground-state band, one of the strongest violations of K-selection rules known. A new program to search for a predicted region of oblate deformation involving neutron deficient isotopes in the Rn/Fr/Ra region was begun. In the area of nuclear astrophysics, as part of a study of the onset of the rp-Process, a set of measurements searching for possible new resonances for ^{14}O+α and ^{17}F+p reactions was completed and a coincidence experiment measuring the ^{19}F(^{3}He,t)^{19}Ne(α)^{15}O and ^{19}F(^{3}He,t)^{19}Ne(p)^{18}F reactions in order to determine the rates of the ^{18}F(p,α)^{15}O and ^{18}F(p,γ)^{19}Ne reactions was begun. Experimental measurements of βnα coincidences from the ^{15}N(d,p)^{16}N($\beta^-\nu$)^{16}O(α)^{12}C reaction have also been completed and are currently being analyzed to determine the rate of the ^{12}C(α,γ) reaction. In the APEX collaboration, we have completed the assembly and testing of two position-sensitive Na barrels which surround the axial silicon detector arrays and serve as the e^+ triggers by detecting their back-to-back annihilation quanta were completed. The HI@AGS and RHIC collaborations, construction and implementation activities associated with the space-time-tracker detector and in the design of the central detector for the PHENIX experiment were carried out. Operation of the ESTU tandem accelerator has been reliable, delivering beam on target at terminal voltages as high as 19.3 MV and running for as long as 143 days between tank openings. Fabrication and bench testing of a new negative ion source system have been completed.

6965 (ESM–43) **Satellite structure of the xenon valence shell by electron momentum spectroscopy.** Braidwood, S.; Brunger, M.; Weigold, E. Flinders Univ. of South Australia, Adelaide (Australia). Electronic Structure of Materials Centre. May 1992. [25] Sponsored by Australian Research Council, Canberra, ACT (Australia). Order Number DE93609993. Source: OSTI; NTIS (US Sales Only); INIS.

Momentum distributions and spectroscopic factors are obtained in a high resolution electron momentum spectroscopy (EMS) study of xenon at 1000 eV. The shapes and relative magnitudes of the momentum profiles are in excellent agreement with distorted-wave impulse approximations using the target Dirac-Fock approximation. The DWDF approximation accurately describes the relative magnitudes of the 5p and 5s manifold cross sections as well as the shape of the 5s cross section. The use of nonrelativistic Hartree-Fock wavefunctions gives significantly poorer fits to the data. Spectroscopic factors for transitions belonging to the $^{2}S^{e}_{1/2}$,$P^{0}_{1/2,3/2}$, and $^{2}D^{3}_{3/2,5/2}$ manifolds are assigned up to a separation energy of 45 eV. The spectroscopic strength for the lowest 5s transition is 0.345 ± 0.010 whereas that for the ground state 5p transition is 0.96 ± 0.02. The 5s strength in the continuum above 33.1 eV is 0.115 ± 0.025 and that for the 5p manifold is only 0.03± 0.01. The first momentum profiles belong to excited $^{2}P^{o}$ and $^{2}D^{e}$ manifolds are obtained. The latter, which must be entirely due to d-wave correlations in the xenon ground state, are in good agreement with DF 5d momentum profiles. Comparison is made with several many-body calculations and agreement with the latest relativistic calculation is very good. 26 refs., 3 tabs., 5 figs.

6966 (GSI–92-10) **Properties of the ρ meson in dense nuclear matter.** Herrmann, M. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany); Technische Hochschule Darmstadt (Germany). Fachbereich 5 - Physik. May 1992. 118p. (In German). Order Number DE93742845. Source: OSTI; NTIS (US Sales Only); INIS.

In order to reach a description of the ρ meson, which is in accordance with the principles of the gauge invariance of the electromagnetic interaction, the vector-dominance hypothesis, and the unitarity a model for the ρ meson in the vacuum is developed. Thereafter follows the calculation of the properties of the ρ meson in nuclear matter. First the connection between the spectral function of the ρ meson and the dilepton production rate for an equilibrium state is derived. Then the model for the pion in nuclear matter is described. Following approximations are applied: The description of the pion-baryon interaction pursues non-relativistically and both the width of the delta resonance and the short-range repulsive delta-nucleon interaction is neglected. The self-energy of the ρ meson in nuclear matter following from this description is formally derived from the requirement to couple the ρ meson to a conserved current. The corrections for the 3-point and 4-point vertex resulting from this are calculated and discussed. Thereafter the physical consequences of the changed self-energy of the ρ meson in nuclear matter are considered. By means of the spectral function it is shown that up to the two-fold of the ground-state density the position of the resonance is nearly not changed. At still higher densities the resonances is a little shifted to higher energies. In the range of an invariant mass of about 400 meV a strong increasement concentrated on a small range results. This is caused by coupling to a naked delta-hole state and a pion. Finally the possibilities are discussed to apply the results of this thesis to the prediction of experimental data. Thereby it is proved to be necessary to base on a simulation of the heavy ion reaction. (orig./HSI).

6967 (GSI–92-15) **The generalized collective model.** Troltenier, D. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany); Frankfurt Univ. (Germany). Fachbereich 13 - Physik. Jul 1992. 165p. (In German). Order Number DE93744562. Source: OSTI; NTIS (US Sales Only); INIS.

In this thesis a new way of proceeding, basing on the method of the finite elements, for the solution of the collective Schroedinger equation in the framework of the Generalized Collective Model was presented. The numerically reachable accuracy was illustrated by the comparison to analytically known solutions by means of numerous examples. Furthermore the potential-energy surfaces of the $^{182-196}$Hg, $^{242-248}$Cm, and $^{242-246}$Pu isotopes were determined by the fitting of the parameters of the Gneuss-Greiner potential to the experimental data. In the Hg isotopes a shape consistency of nearly spherical and oblate deformations is shown, while the Cm and Pu isotopes possess an essentially equal remaining prolate deformation. By means of the pseudo-symplectic model the potential-energy surfaces of ^{24}Mg, ^{190}Pt, and ^{238}U were microscopically calculated. Using a deformation-independent kinetic energy so the collective excitation spectra and the electrical properties (B(E2), B(E4) values, quadrupole moments) of these nuclei were calculated and compared with the experiment. Finally an analytic relation between the (g_R-Z/A) value and the quadrupole moment was derived. The study of the experimental data of the $^{166-170}$Er isotopes shows an in the framework of the measurement accuracy a sufficient agreement with this relation. Furthermore it is by this relation possible to determine the effective magnetic dipole moment parameter-freely. (orig./HSI).

6968 (INIS-BR–3112) **Proceedings of the 5. Swieca School in Nuclear Physics.** Bertulani, C.A. (ed.). Sociedade Brasileira de Fisica, Sao Paulo, SP (Brazil). 1991[258] (CONF-9102193–: 5. Swieca School in Nuclear Physics, Campos do Jordao (Brazil), 19-28 Feb 1991). Order Number DE93609952. Source: OSTI; NTIS (US Sales Only); INIS.

Studies on nuclear properties, nuclear models, and particle production in heavy ion collisions, are presented. (M.C.K.).

6969 (INIS-BR–3112, pp. 1-70) **Description of nuclear properties.** Faessler, A. (Tuebingen Univ. (Germany). Dept. of Physics). Sociedade Brasileira de Fisica, Sao Paulo, SP (Brazil). 1991. [258] (CONF-9102193–: 5. Swieca School in Nuclear Physics, Campos do Jordao (Brazil), 19-28 Feb 1991). In *Proceedings of the 5. Swieca School in Nuclear Physics.* Order Number DE93609952. Source: OSTI; NTIS (US Sales Only); INIS.

The lectures want to give a survey about new developments in the description of nuclei. In a first chapter we try to derive nuclear properties from the basis theory of quantum chromodynamics. This is not rigorously possible. There are still many cracks in the bridge between QCD and nuclear structure. The basic ingredient for nuclear structure calculations is the nucleon-nucleon interaction. We shall discuss the nucleon-nucleon interaction in a quark model. In a further chapter we discuss the way to come from a bare nucleon-nucleon interaction in free space to an effective nucleon-nucleon interaction in a limited model space for nuclear structure calculations. Such nuclear structure calculations can be done as shell model calculations. But they are due to the large number of configurations limited to light nuclei. We discuss possibilities (MONSTER and VAMPIR) to enlarge the model space for medium heavy and heavy nuclei. As the example of the low lying isovector 1^+ states we discuss collective models (Bohr - Mottelson Model, interacting Boson Model) with proton and neutron degrees of freedom. The same states can also be described microscopically with the Quasi-Particle Random Phase Approximation (QRPA). We discuss the removal of spurious states in RPA. We also discuss the calculation of form factors and compare with inelastic electron scattering data. Finally we apply QRPA to the double-beta decay. Grand unified models predict, that the neutrino is identical with his antiparticle, that it has a finite mass and a weak right-handed interaction. If these properties are found the standard model of the strong and the electro-weak interaction can not be correct. Presently we can only derive from lower limits of the half lives of neutrinoless double-beta decays upper limits of the neutrino mass and of the right-handedness of the weak interaction and lower limits of the mass of the right handed heavy vector boson, if a specific grand unified model is given. (author).

6970 (INIS-BR–3112, pp. 71-132) **The nuclear response in extended RPA theories.** Wambach, J. (Forschungszentrum Juelich GmbH (Germany). Inst. fuer Kernphysik). Sociedade Brasileira de Fisica, Sao Paulo, SP (Brazil). 1991. [258] (CONF-9102193–: 5. Swieca School in Nuclear Physics, Campos do Jordao (Brazil), 19-28 Feb 1991). In *Proceedings of the 5. Swieca School in Nuclear Physics.* Order Number DE93609952. Source: OSTI; NTIS (US Sales Only); INIS.

Linear response theories for small-amplitude nuclear motion are discussed. A review is given of the Random-Phase-Approximation and its successes and shortcomings are pointed out. Systematic improvements are presented which include two-particle two-hole excitations and account for dissipative effects due to binary collisions of nucleons in the mean field. These improved theories describe inelastic scattering experiments satisfactorily over a wide kinematical range. (author).

6971 (LBL–32818) **NMR on beta-emitting fragment ^{43}Ti.** Matsuta, K. (Osaka Univ., Toyonaka (Japan). Dept. of Physics); Ozawa, A.; Nojiri, Y.; Minamisono, T.; Fukuda, M.; Momota, S.; Ohtsubo, T.; Fukuda, S.; Sugimoto, K.; Tanihata, I.; Yoshida, K.; Omata, K.; Alonso, J.R.; Krebs, G.F.; Symons, T.J.M. Lawrence Berkeley Lab., CA (United States). Aug 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-920721–14: 6. international conference on nuclei far from stability and 9th international conference on atomic masses and fundamental constants, Bernkastel-Kues (Germany), 19-24 Jul 1992). Order Number DE93002553. Source: OSTI; NTIS; INIS; GPO Dep.

NMR has been observed on beta-emitting ^{43}Ti produced in the 116 AMeV ^{46}Ti on C collision by means of asymmetric beta decay. The observed spin polarization of ^{43}Ti showed a reverse tendency in its momentum dependence compared with that observed for fragments produced in the ^{40}Ca on Au collision. This suggests negative angle deflection of ^{43}Ti due to the nuclear attractive potential. From the observed NMR spectrum, the magnetic moment of ^{43}Ti was determined to be $|\mu| = (0.85 \pm 0.02)\mu_N$. The value is significantly quenched from the single particle value $-1.91\ \mu_N$, which shows a strong effect due to meson exchange currents and configuration mixing.

6972 (UCRL-JC–111939) **Oblate L = 1 bands in $^{194,196-201}$Pb, and ^{193}Hg.** Becker, J.A. (Lawrence Livermore National Lab., CA (United States)); Kuhnert, A.; Stoyer, M.A.; Brinkman, M.J.; Wang, T.F.; Roy, N.; Cizewski, J.A.; Stephens, F.S.; Deleplanque, M.A.; Diamond, R.M.; Azaiez, F.; Macchiavelli, A.O.; Korten, W.; Draper, J.E. Lawrence Livermore National Lab., CA (United States). Nov 1992. 15p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract W-7405-ENG-48 ;AC03-76SF00098. (CONF-921116–12: 12. international conference on the application of accelerators in research and industry, Denton, TX (United States), 2-5 Nov 1992). Order Number DE93003467. Source: OSTI; NTIS; INIS; GPO Dep.

Reports of recent experiments have included observations of regular and irregular bands in neutron deficient Pb isotopes with A=194, 196–201. The bands are populated strongly in HI,xn reactions. The shared characteristics of the bands include: (1) Bandhead energies of few MeV; (2) High bandhead spin; (3) Large alignments; (4) Small dynamic moments of inertia, and (5) Strong L = 1 transitions and weaker L = 2 crossover transitions, with B(MI/B(E2)) $\approx 20\ \mu^2/e^2b^2$. Lifetimes of band members in the ^{198}Pb regular band are B(MI) $\approx$ 1 W.u., and B(E2) $\approx$ 10 W.u. (with large errors). These observations are consistent with an interpretation of the regular structures as collective oblate bands with both proton and neutron excitations involved; the closed proton shell at Z = 82 is broken, and coupled to $v(i_{13/2})^{-n}$ excitations. The irregular structures may correspond to triaxial shapes, with similar orbits involved. A similar structure has been also found in ^{193}Hg.

6973 (UM-P–91/94) **IBM symmetries in realistic shell model states.** Halse, P. Melbourne Univ., Parkville, VIC (Australia). School of Physics. [1992]. [8] Sponsored by Australian Research Council, Canberra, ACT (Australia). Order Number DE93610037. Source: OSTI; NTIS (US Sales Only); INIS.

An approximate dynamical symmetry referring to IBM-type bosons is shown to be latent in the shell model eigenfunctions for ^{54}Cr and ^{56}Fe. No symmetry is assumed in the approach, which invokes only a realistic shell model interaction and an interpretation of the bosons as nucleon pairs. Particular emphasis is placed on the levels involved in M1 excitation. 25 refs., 4 tabs., 1 fig.

6974 (UM-P–91/102) **Description of transitional nuclei in the sdg boson model.** Lac, V.S.; Kuyucak, S. Melbourne Univ., Parkville, VIC (Australia). School of Physics. [1992]. [40] Sponsored by Australian Research Council, Canberra, ACT (Australia). Order Number DE93610036. Source: OSTI; NTIS (US Sales Only); INIS.

The study of the transitional nuclei in the framework of the sdg boson model was necessitated by recent measurements of E2 and E4 transitions in the Pt and Os isotopes which can not be explained in the sd boson models. It is shown how γ-unstable and triaxial shapes arise from special choices of sdg model Hamiltonians. Ways of limiting the number of free parameters through consistency and coherence conditions are also discussed. A satisfactory description of E2 and E4 properties is obtained for the Pt and Os nuclei, which also predicts dynamic shape transitions in these nuclei. 36 refs., 10 tabs., 12 figs.

6975 (UM-P–92/07) **Band gaps for the relativistic Mathieu potential.** Clerk, G.J.; McKellar, B.H.J. Melbourne Univ., Parkville, VIC (Australia). School of Physics. [1992]. [24] Sponsored by Australian Research Council, Canberra, ACT (Australia). (OZ-P–92/04.). Order Number DE93609994. Source: OSTI; NTIS (US Sales Only); INIS.

A study of the band structure of a massless particle in a cosine potential is made via the Dirac equation. It is shown that every alternate band gap disappears as a consequence of a periodicity of the potential combined with a peculiar symmetry of the Dirac equation. This basic potential is then used to study a simple one-dimensional model of the nucleus from which it is ascertained that

modelling the mean field of the quarks in the nucleus via a pure scalar potential is unsatisfactory. A simple extension involving a combined scalar and vector potential is then proposed as a possible solution to this problem. The effect of the addition of this vector component to the band structure is also investigated. 32 refs.

6976 (UM-P-92/11) **Comment on 'Mixed-symmetry 2^+ state of ^{56}Fe in realistic shell model'.** Halse, P. Melbourne Univ., Parkville, VIC (Australia). School of Physics. [1992]. [3] Sponsored by Australian Research Council, Canberra, ACT (Australia). Order Number DE93610038. Source: OSTI; NTIS (US Sales Only); INIS.

The purpose of this comment is to critically discuss some statements made by Nakada, H. et al. with reference to a large-scale shell model calculation for ^{56}Fe and its analysis to determine the properties of the pair analogue of the Interacting Boson Model mixed-symmetry 2^+ state. It is stressed that a consistent description involving the shell model calculation would require either a more appropriate microscopic interpretation or the identification of the additional bosons needed to model both modes; at 3 and 10 MeV. 14 refs.

6632 Radioactivity and Electromagnetic Transitions (Excluding Fission)

Refer also to citation(s) 6800, 6941, 6956, 6958, 6967, 7000

6977 (FZR-92-03) **Unified description of quasi-free and resonant processes of hypernuclear production and decay.** Wuensch, R. (Forschungszentrum Rossendorf e.V. (FZR), Rossendorf bei Dresden (Germany). Inst. fuer Kern- und Hadronenphysik). Forschungszentrum Rossendorf e.V. (FZR), Rossendorf bei Dresden (Germany). Mar 1992. 26p. Contract BMFFT 06DR107. Order Number DE93742661. Source: OSTI; NTIS (US Sales Only); INIS.

We review a unified description of resonant and quasi-free hypernuclear production reactions on the basis of the continuum shell-model. Both reaction mechanisms are considered as boundary cases of the same process. We apply the model to the (K^-, π) and to the (π, K^+) reaction on light target nuclei. Particular attention is given to the consequences of the shallow hyperon-nucleus potential. Hypernuclear disintegration by baryon emission is considered as transition from the bound to the unbound part of the configurational space. (orig.).

6978 (GSI-92-37(prepr.)) **New island of cluster emitters.** Poenaru, D.N. (Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany)); Greiner, W.; Gherghescu, R. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany). Jun 1992. 21p. Order Number DE93742678. Source: OSTI; NTIS (US Sales Only); INIS.

A new region of proton-rich parent nuclei decaying by spontaneous cluster emission with a measurable branching ratio relative to alpha-decay is predicted within analytical superasymmetric fission model. After a brief presentation of the model and of the seven mass tables used to calculate the released energy, the obtained results are discussed. Measurable half-lives and branching ratios are estimated for ^{12}C, ^{16}O, ^{28}Si, and other cluster radioactivities of some nuclides having proton and neutron numbers in the range Z=56-64 and N=58-72. Such nuclei far from stability could be produced in reactions induced by radioactive beams. (orig.).

6979 (JINR-7-46-90, pp. 46-51) **On mixing ratios coefficients of γ-transitions between quadrupole states of even-even $^{114-124}$Sn nuclei.** Demidov, A.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (Russian Federation). Inst. Atomnoj Ehnergii); Mikhajlov, I.V.; Vdovin, A.I.; Safarov, R.R. Joint Inst. for Nuclear Research, Dubna (Russian Federation). 1990. (In Russian). In *JINR rapid communications: Collection.* [77] Order Number DE93609511. Source: OSTI; NTIS (US Sales Only); INIS.

New experimental data of mixing ratios δ(E2/M1) in γ-transitions $2_i^+ \rightarrow 2_1^+$ (i=2-4) in $^{114-124}$Sn and results of their theoretical treatment in the framework of the quasiparticle-phonon nuclear model are presented. It is shown that the model wave functions of the 2_3^+ states in $^{114-120}$Sn and of the 2_2^+ states in ^{122,124}Sn have considerable two-phonon component and higher 2^+-states have noncollective nature. 10 refs.; 1 tab.

6980 (Juel-2663) **Measurement of level lifetimes in the ps range and model interpretations for neutron-rich A $\simeq$ 100 nuclei.** Liang Meihua. Forschungszentrum Juelich GmbH (Germany). Inst. fuer Kernphysik; Koeln Univ. (Germany). Aug 1992. 123p. Order Number DE93744616. Source: OSTI; NTIS (US Sales Only); INIS.

The nuclear structure of A $\propto$ 100 nuclei has been studied in the frame of this thesis with a recently developed β - γ - γ triple coincidence fast timing technique and different models such as shell model, hydrodynamic model, Nilsson and particle-rotor models. This technique which allows the measurement of the level lifetimes in the ps range has been applied at JOSEF at the research reactor DIDO of KFA Juelich in studes of the short-lived neutron-rich nuclei in the A $\simeq$ 100 region. Lifetimes of level in ^{96,98,100} ZR, $^{99,101-104}$ Nb, $^{100-105}$ Mo have been measured, which are in many cases completely new, and otherwise more precise than previously published data. From the lifetimes of the members of rotational bands, the size of the nuclear deformations has been deduced. (orig./HSI).

6981 (LA-UR-92-3785) **Decay data evaluation for ENDF/B-VI.** England, T.R. (Los Alamos National Lab., NM (United States)); Wilson, W.B.; Katakura, J.; Mann, F.M.; Schenter, R.E.; Reich, C.W. Los Alamos National Lab., NM (United States). [1992]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-921046-13: Symposium on nuclear data evaluation methodology, Upton, NY (United States), 12-16 Oct 1992). Order Number DE93003837. Source: OSTI; NTIS; INIS; GPO Dep.

ENDF/B-VI decay files depart from earlier versions in that model data are now used as needed to provide a complete set of average decay energies and spectra. Delayed neutron spectra are also included for the first time. There are 979 radioactive nuclides in the file, and all but 8 have decay spectra. The use of model data has eliminated the "Pandemonium" problem in aggregate fission product calculations, and it greatly improves decay heat calculations. This report describes the data base with an emphasis on the need for models used in combining measurement and model data. Extraction of only the evaluated measurement data is simple, should it be desired by users. We present here an abbreviated chronology of the development of ENDF/B-VI.

6982 (UM-P-91/109) **Dynamic shape transitions in the sdg boson model.** Kuyucak, S. Melbourne Univ., Parkville, VIC (Australia). School of Physics. [1992]. [9] Sponsored by Australian Research Council, Canberra, ACT (Australia). Order Number DE93610047. Source: OSTI; NTIS (US Sales Only); INIS.

The dynamic evolution of shapes in the sdg interacting boson model is investigated using the angular momentum projected mean field theory. Deformed nuclei are found to be quite stable against shape changes but transitional nuclei could exhibit dynamic shape transitions in the region L = 10-20. Conditions of existence and experimental signatures for dynamic shape transitions are discussed together with a likely candidate, ^{192}Os. 13 refs., 3 figs.

6633 Nuclear Reactions and Scattering, General

Refer also to citation(s) 6968

6983 (ANL/EP/CP-78013) **Generation of covariance data among values from a single set of experiments.** Smith, D.L. Argonne National Lab., IL (United States). Engineering Physics Div. [1992]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9210173-3: Nuclear Energy Agency Science Committee (NEANSC) specialists meeting on evaluation and processing of covariance data, Oak Ridge, TN (United States), 7-9 Oct 1992). Order Number DE93004192. Source: OSTI; NTIS; INIS; GPO Dep.

Modern nuclear data evaluation methods demand detailed uncertainty information for all input results to be considered. It can be shown from basic statistical principles that provision of a covariance matrix for a set of data provides the necessary information for

its proper consideration in the context of other included experimental data and/or a priori representations of the physical parameters in question. This paper examines how an experimenter should go about preparing the covariance matrix for any single experimental data set he intends to report. The process involves detailed examination of the experimental procedures, identification of all error sources (both random and systematic); and consideration of any internal discrepancies. Some specific examples are given to illustrate the methods and principles involved.

6984 (BNL–47979) **Monte Carlo studies of positron implantation in elemental metallic and multilayer systems.** Ghosh, V.J.; Welch, D.O.; Lynn, K.G. Brookhaven National Lab., Upton, NY (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-920829–1: 5. international workshop on slow-positron beam techniques for solids and surfaces, Jackson, WY (United States), 6-10 Aug 1992). Order Number DE93003474. Source: OSTI; NTIS; GPO Dep.

We have used a Monte Carlo computer code developed at Brookhaven [1,2] to study the implantation profiles of 1-10 keV positrons incident on a wide range of semi-infinite metals and multilayer systems. Our Monte Carlo program accounts for elastic scattering as well as inelastic scattering from core and valence electrons, and includes the excitation of plasmons. The implantation profiles of positrons in many metals as well as Pd/Al, and Al/Co/Si multilayers are presented. Scaling relations and closed-form expressions representing he implantation profiles are also discussed.

6985 (CONF-921046–6) **The resolution of discrepancies among nuclear data.** Peelle, R. Oak Ridge National Lab., TN (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Symposium on nuclear data evaluation methodology; Upton, NY (United States); 12-16 Oct 1992. Order Number DE93002828. Source: OSTI; NTIS; INIS; GPO Dep.

Significant differences among input data occur in the evaluation of nuclear data because it is difficult to achieve experimental results with the accuracy required for some applications. Types of "discrepancies" are classified. The means are reviewed by which an evaluator may treat discrepancies in the process of evaluation. When all means fail that are based on how the discrepant data were obtained, the perplexed evaluator must sometimes combine discrepant data based just on the stated values and uncertainties; techniques for treating such challenges are compared. Some well-known data discrepancies are examined as examples.

6986 (DOE/ER/40406–5) **Investigations of nuclear structure and nuclear reactions induced by complex projectiles: Progress report, September 1, 1991–August 31, 1992.** Sarantites, D.G. Washington Univ., St. Louis, MO (United States). Dept. of Chemistry. [1992]. 84p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER40406. (COO–40406-5). Order Number DE93004602. Source: OSTI; NTIS; INIS; GPO Dep.

The research program described touches five areas of nuclear physics: nuclear structure studies at high spin (hyperdeformation in the mass A $\simeq$ 182 region, structure of ^{182}Hg and ^{182}Au at high spin, a highly deformed band in ^{136}Pm and the anomalous $h_{11/2}$ proton crossing in the A$\sim$135 superdeformed region), studies at the interface between structure and reactions (population of entry states in heavy-ion fusion reactions, nuclear structure effects in proton evaporation spectra, nuclear structure- dependent entry state population by total spectroscopy, entrance channel effects in fusion near the barrier, lifetimes of subbarrier α particles by the atomic clock method), production and study of hot nuclei (the statistical model evaporation code EVAP, statistical emission of deuterons and tritons from highly excited compound nuclei, heavy-fragment emission as a probe of the thermal properties of highly excited compound nuclei, use of incoming-wave boundary condition transmission coefficients in the statistical model: implications in the particle evaporation spectra, study of transparency in the optical model), reaction mechanism studies (binary character of highly dissipative ^{209}Bi + ^{136}Xe collisions at E/A=28.2 MeV), and development and use of novel techniques and instrumentation in these areas of research (including a 4π channel selection device, a novel x-ray detector, and a simple channel-selecting detector).

6987 (ESM–41) **Convergent close-coupling calculations of electron-hydrogen scattering.** Bray, Igor (Flinders Univ. of South Australia, Adelaide (Australia). Electronic Structure of Materials Centre); Stelbovics, A.T. Flinders Univ. of South Australia, Adelaide (Australia). Electronic Structure of Materials Centre. Apr 1992. [32] Sponsored by Australian Research Council, Canberra, ACT (Australia). Order Number DE93610049. Source: OSTI; NTIS (US Sales Only); INIS.

The convergence of the close-coupling formalism is studied by expanding the target states in an orthogonal L^2 Laguerre basis. The theory is without approximation and convergence is established by simply increasing the basis size. The convergent elastic, 2s, and 2p differential cross sections, spin asymmetries, and angular correlation parameters for the 2p excitation at 35, 54.4, and 100 eV are calculated. Integrated and total cross sections as well as T-matrix elements for the first five partial waves are also given. 30 refs., 3 tabs., 9 figs.

6988 (ESM–42) **Calculation of spin-dependent observables in electron-sodium scattering using the coupled-channel optical method.** Bray, Igor. Flinders Univ. of South Australia, Adelaide (Australia). Electronic Structure of Materials Centre. Apr 1992. [8] Order Number DE93610050. Source: OSTI; NTIS (US Sales Only); INIS.

The calculations of the 3^2S and 3^2P spin asymmetries and the angular momentum for singlet and triplet scattering for projectile energies of 10 and 20 eV is presented. Together these observables give a most stringent test of any electron-atom scattering theory. An excellent agreement was found between the results of the coupled-channel optical method and experiment, which for the spin asymmetries can only be obtained by a good description of the couplings between the lower-lying target states and the target continuum. 10 refs., 2 figs.

6634 Specific Nuclear Reactions and Scattering

Refer also to citation(s) 5159, 5168, 6181, 6403, 6891, 6892, 6919, 6926, 6962, 6964, 6977, 6986, 7249, 7460

6989 (ANL/EP/CP–77792) **A suggestion for specification of the neutron energy scale in measurements, analyses and evaluations of differential reaction cross-section data.** Smith, D.L. Argonne National Lab., IL (United States). Engineering Physics Div. [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-921046–8: Symposium on nuclear data evaluation methodology, Upton, NY (United States), 12-16 Oct 1992). Order Number DE93002931. Source: OSTI; NTIS; INIS; GPO Dep.

Neutron energy distributions (spectra) in differential neutron cross section measurements are represented conventionally by giving the energies (not well defined) and full widths at half maximum of the spectra. In most modern experiments, it is possible for investigators to provide a much more thorough representation of neutron spectra. However, reporting such information would entail more numerical detail than appears practical to document. Therefore, it is suggested that such spectra be represented in publications and files of experimental data by providing the following four moments of each distribution: mean value (energy), standard deviation (resolution), skewness (asymmetry), and kurtosis (sharpness). Implementation of such a standard for data reporting would offer evaluators a much more complete and rational basis for comparing reported values and performing evaluations than previously possible. Some examples are provided to illustrate the concepts.

6990 (ANL/PHY/CP–77920) **From simple to complex reactions: Nuclear collisions near the Coulomb barrier.** Rehm, K.E. Argonne National Lab., IL (United States). Physics Div. [1992]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9208190–1: 27. Zakopane School of Physics conference, Zakopane (Poland), 31 Aug - 3 sep 1992). Order Number DE93004197. Source: OSTI; NTIS; INIS; GPO Dep.

Collisions between two heavy nuclei produce a diverse spectrum of reaction modes which is much wider than that observed in light

ion studies. For the latter case, two processes are observed: direct reactions and compound nucleus formation. Heavy ion reaction studies on the other hand have identified additional processes such as deep-inelastic scattering, incomplete fusion and quasi-fission reactions. While the boundaries between the various processes are usually not well defined, it is generally accepted that with increasing overlap of the two nuclei the interaction evolves from distant collisions where only elastic scattering and Coulomb excitation processes occur, through grazing-type collisions associated with quasi-elastic reactions to deep-inelastic and fusion-fission processes requiring a substantial nuclear overlap. Varying the bombarding energy is a convenient way to change the overlap of the two nuclei. Measurements of excitation functions can thus probe the onset and the interplay of the various reaction modes. Experiments at bombarding energies in the vicinity of the Coulomb barrier are particularly suited for comparisons with theoretical predictions since the small number of degrees of freedom involved in the interaction greatly simplifies the calculations. In the first part of this contribution a short overview is given on the status of heavy ion reaction studies at energies in the vicinity of the Coulomb barrier. In the second part two experiments, one involving simple and the other studying complex reactions, are discussed in more detail.

6991 (ANL/PHY/RP--77845) **Description of the programs and facilities of the Physics Division.** Argonne National Lab., IL (United States). Physics Div. Oct 1992. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93004039. Source: OSTI; NTIS; GPO Dep.

The major emphasis of our experimental nuclear physics research is in Heavy-Ion Physics, centered at the recently completed ATLAS facility. ATLAS is a designated National User Facility and is based on superconducting radio-frequency technology developed in the Physics Division. In addition, the Division has strong programs in Medium-Energy Physics and in Weak-Interaction Physics as well as in accelerator development. Our nuclear theory research spans a wide range of interests including nuclear dynamics with subnucleonic degrees of freedom, dynamics of many-nucleon systems, nuclear structure, and heavy-ion interactions. This research makes contact with experimental research programs in intermediate-energy and heavy-ion physics, both within the Division and on the national scale. The Atomic Physics program, the largest of which is accelerator-based, primarily uses ATLAS, a 5-MV Dynamitron accelerator and a highly stable 150-kV accelerator. A synchrotron-based atomic physics program has recently been initiated with current research with the National Synchrotron Light Source in preparation for a program at the Advanced Photon Source, at Argonne. The principal interests of the Atomic Physics program are in the interactions of fast atomic and molecular ions with solids and gases and in the laser spectroscopy of exotic species. The program is currently being expanded to take advantage of the unique research opportunities in synchrotron-based research that will present themselves when the Advanced Photon Source comes on line at Argonne. These topics are discussed briefly in this report.

6992 (BNL--48035) **Methods used to produce nuclear data files for 0--10 GeV incident neutrons and protons.** Pearlstein, S. Brookhaven National Lab., Upton, NY (United States). [1992]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-921046--9: Symposium on nuclear data evaluation methodology, Upton, NY (United States), 12-16 Oct 1992). Order Number DE93003167. Source: OSTI; NTIS; INIS; GPO Dep.

Nuclear models for calculating medium energy data are in need of a unified theory. For energies above 100 MeV the incident nucleon wavelength is smaller than its collision mean-free-path within the target nucleus so that an intra-nuclear-cascade model, for example, is appropriate. For energies below 100 MeV the incident nucleon wavelength is larger than the dimensions of the target nucleus so that a partial wave nuclear model, for example, is appropriate. Comparisons between calculations and experiments show discrepancies even when using appropriate models. Experimental data alone is rarely convergent or sufficient to define an evaluation over the complete range of interest. The evaluator is therefore left to selectively choose from a diverse arsenal of experimental data, nuclear models and nuclear systematics those tools that may best help him to complete an evaluation. These points are illustrated by the use of calculation and experiment in the evaluation of nucleon data for ^{12}C.

6993 (BONN-IR--91-71) **Deuteron photofission in the range $E_\gamma \leq 1$ GeV.** Erbs, P. Bonn Univ. (Germany). Physikalisches Inst.; Bonn Univ. (Germany). Mathematisch-Naturwissenschaftliche Fakultaet. Dec 1991. 159p. (In German). Order Number DE93742756. Source: OSTI; NTIS (US Sales Only); INIS.

The differential cross section and polarisation observables of the deuteron photodisintegration are calculated in a relativistic quantum hadron dynamical model at photon lab. energies E_γ up to 1 GeV. We have used the method of Feynmangraphs to calculate the T-Matrix of the process $\gamma d \rightarrow p n$. A central point is the consideration of boxgraphs with baryon-resonances with spin $\leq 3/2$ and masses < 2 GeV. The exchange of π-, ω-, ρ- and η-mesons is used to approximate the final state interaction. The analytical structure of the elementary amplitudes of these boxgraphs is investigated with respect to their offshell behaviour. Moreover, the influence of the deuteron wavefunction, including P-waves, and the meson formfactors are major points under consideration. It is shown that the 'spectator model pole' yields the most significant contribution to the amplitude of the planar boxgraphs. For the nonplanar graph of the MEC, which is required to restore gauge invariance, the spectator-model leads to unphysical singularities. (orig.).

6994 (BONN-IR--92-06) **Calculation of nucleon-deuteron breakup processes with realistic, charge-dependent potential.** Frank, T. Bonn Univ. (Germany). Physikalisches Inst.; Bonn Univ. (Germany). Mathematisch-Naturwissenschaftliche Fakultaet. Mar 1992. 153p. (In German). Order Number DE93742757. Source: OSTI; NTIS (US Sales Only); INIS.

Neutron-deuteron breakup cross sections obtained within the framework of AGS theory are presented. As input the separable W-matrix representation of the two-body T matrix for the original Paris potential and for a charge dependent modification is used. A criterion to choose an optimal representation based on the Schmidt norm of the kernel of the AGS equations is presented. The results are compared with data from kinematically complete experiments at 10.3 MeV and 13.0 MeV. The neutron-neutron (nn) scattering length is extracted from the cross section of a nn-FSI configuration. It is shown that a reliable analysis of a given experimental situation requires the inclusion of about 400 neighbouring configurations in order to simulate finite energy and angle resolutions. In view of the huge demand on computational resources the simplifying yet very accurate W-matrix method is seen to be an algorithm particularly well suited for such realistic analyses. (orig.).

6995 (CONF-921046--7) **Cross section parameterization in the resolved resonance region.** Larson, N.M. Oak Ridge National Lab., TN (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Symposium on nuclear data evaluation methodology; Upton, NY (United States); 12-16 Oct 1992. Order Number DE93003022. Source: OSTI; NTIS; INIS; GPO Dep.

Experimental techniques, methods, and equipment have evolved to provide more accurate neutron cross section data wit better energy resolution. Keeping pace with those developments has been a challenge for data analysts; commensurate improvements in analysis tools are required. In this paper, analysis techniques for neutron time-of-flight data in the resolved resonance region are discussed, with emphasis on contemporary needs.

6996 (ESM--40) **Distorted-wave calculation of He(e,2 e) including core-exchange amplitudes.** Konovalov, D.A.; McCarthy, I.E. Flinders Univ. of South Australia, Adelaide (Australia). Electronic Structure of Materials Centre. Apr 1992. [14] Sponsored by Australian Research Council, Canberra, ACT (Australia). Order Number DE93610072. Source: OSTI; NTIS (US Sales Only); INIS.

Distorted-wave Born approximation (DWBA) calculations are reported for coplanar symmetric ionization of helium at energies of 100 and 200 eV. The best possible one-configuration incident distorted wave functions together with the capture scattering have been used to produce a better agreement with absolute measurements at 100 eV compared with the previous DWBA calculations. However the discrepancy between experiment and theory at 200

eV for large angles has not been resolved by these modifications. Moreover capture scattering has been found negligible at 28.6 to 200 eV. Similar DWBA calculations for hydrogen close to the threshold are also reported. Very good agreement with experiment has been found at 17.6 eV. 20 refs., 4 figs.

6997 (ESM-45) **Spin-dependent observables in electron-sodium scattering calculated using the coupled-channel optical method.** Bray, I.; McCarthy, I.E. Flinders Univ. of South Australia, Adelaide (Australia). Electronic Structure of Materials Centre. Jun 1992. [22] Sponsored by Australian Research Council, Canberra, ACT (Australia). Order Number DE93610073. Source: OSTI; NTIS (US Sales Only); INIS.

The calculations of 3^2S-3^S and 3^2S-3^2P electron sodium scattering at 1 to 40 eV is presented. An excellent agreement with measurements of the spin asymmetries and P'/P for both channels, and L the angular momentum for singlet, triplet, and summed spin states at all energies was found. This may only be achieved at energies above the ionization threshold by including the coupling of the low-lying target discrete states to the target continuum. 25 refs., 6 figs.

6998 (GSI-92-11) **Fragment production and collective motion in central Au+Au collisions.** Fan Zhiguo. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany). May 1992. 47p. Order Number DE93742677. Source: OSTI; NTIS (US Sales Only); INIS.

The light charged particles (Z=1,2) and intermediate mass fragments ($3 \leq Z \leq 15$) emitted within the forward cone $\theta \leq 30$deg in Au+Au collisions at 150 A.MeV beam energy have been measured at SIS-Darmstadt, using the phase I set-up of the 4π detector. The central collisions have been selected by a cut on the total charged-particle multiplicity and a cut on the 'transverse momentum directivity' D, a vector sum of the transverse momenta of the measured charge particles. For the events of the central collisions, large transverse momenta are observed especially for clusters ($Z \geq 3$), and the multiplicity of intermediate mass fragments in the acceptance of our setup is about 4. The calculations of a statistical model, a modified version of FREESCO, are compared to the experimental results. A reasonably good agreement has been found between the calculations and the experimental data for the fragment productions and corresponding velocity distributions. The separation of collective and thermal motion for the emitted fragments has been attained. (orig.).

6999 (GSI-92-13) **A microscopical N-particle theory for the description of cluster formation and non-equilibrium phase transitions in strongly interacting fermionic systems.** Peilert, G. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany); Frankfurt Univ. (Germany). Fachbereich 13 - Physik. Jun 1992. 223p. (In German). Order Number DE93744615. Source: OSTI; NTIS (US Sales Only); INIS.

In this thesis a model for the description of heavy ion reactions is presented, which is able to describe in the incident-energy range from about 30 MeV per nucleon up to about 1 GeV per nucleon also the many-particle aspects in such reactions. A method is presented by which the Fermi properties of the nucleons can be simulated ba means of a semiclassical Pauli potential. By means of the Metropolis algorithm then the static properties of a free Fermi gas both of infinite nuclear matter and finite nuclei is studied. For this purpose a microscopical Hamilton function is developed, by which the nucleon-nucleon interaction can be described semiclassically. On the base of this Hamilton function then a dynamical theory for the description of many-particle systems is developed. For this purpose the most important kinetic equantions for classical and quantum mechanical systems as well as for Wigner densities are presented. Then the most important macroscopical and microscopical models, which are based on these equations, are discussed, before the microscopical quantum molecular dynamics (QMD) model is developed. By means of the system Nb + Nb the dependence of the most importent fragmentation properties (multiplicities, excitation energies, and densities of the pre-fragments) on incident energy, impact parameter, as well as the reaction time is studied. Finally the multi-fragmentation process in heavy ion reactions is studied. A two-stage model is developed, in which in the first stage the QMD model is used in order to describe the pre-equilibrium processes as well as the formation of excited pre-fragments. The decay of these excited fragments is then described by one of the statistical multi-fragmentation models. (orig.).

7000 (GSI-92-14) **Two-phonon-octupole excitation in ^{208}Pb.** Martin, N. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany); Frankfurt Univ. (Germany). Fachbereich 13 - Physik. Jun 1992. 95p. (In German). Order Number DE93744614. Source: OSTI; NTIS (US Sales Only); INIS.

In the framework of the present thesis quasi-elastic processes in the reactions ^{206} Pb+^{208} Pb and ^{208} Pb+^{208} Pb were studied at an incident energy slightly above the Coulomb barrier (6.2 MeV/u) were studed. By means of the measured Particle-gamma correlations the quasi-elastic collisions were separated from the deep inelastic ones. Determined were the absolute cross sections and angular distributions of the exitation by inelastic collisions as well as by one- and two-neutron transfer. For the states excited by inelatic scattering the multiplicities of the γ quanta emitted in their decay were experimentally determined. The measured angular distributions of the inelastic reactions were compared with CCBA calculations. As most important result of this thesis the experimental detection of a member of the 2-phonon-octupole multiplet is to be considered. A hitherto unknown γ transition in the spectrum of $^{-2-0-8}$ Pb with an energy of 2.485 MeV was detected. Because of the measured $\gamma\gamma$ coincidence ratios in ^{208} Pb this transition was assigned to the level scheme of ^{208}Pb. Its decay to the 1-phonon state 3^- pursues via an E1-transition to the 5^- -state and a following E2-transition. The angular distribution of the 2-phonon-octupole state was calculated in the framework of the CCBA and compared with the experiment. The comparison with the CCBA calculation indicates a spin of $I^\pi=6^+$ or 4^+ . The experimental angular distributions of the one-neutron transfer reactions to ^{207} Pb and ^{209} Pb were compared with DWBA calculations. (orig./HSI).

7001 (GSI-92-20) **Study of the elastoplasticity of nuclear matter and its influence on the dynamics of heavy ion collisions by the method of the δ electron spectroscopy.** Rhein, M.D. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany); Technische Hochschule Darmstadt (Germany). Fachbereich 5 - Physik. Aug 1992. 157p. (In German). Order Number DE93744564. Source: OSTI; NTIS (US Sales Only); INIS.

In the framework of this thesis the spectral distribution of the δ electrons emitted in dissipative collisions of Pb+Pb at 12.0 MeV/u was measured in the energy range of $1.0 \text{ MeV} \leq E_e \leq 8.0 \text{ MeV}$. For the comparison of the δ electron spectra obtained in dissipative collisions with theoretical predictions the nuclear trajectories were calculated with the stochastic reaction model of Feldmeier. The friction forces calculated in this model are derived from microscopical processes. With the aim to increase the stopping forces in the framework of a microscopical reaction model, the assumptions of a diabatic behaviour of the single-particle levels implemented in the Diabatic two-center Shell Model of Prof. Noerenberg were taken over to the friction model of Feldmeier. The determination of the parameter pursues by the fitting of the δ electron spectra to the experimental distributions. (orig./HSI).

7002 (GSI-92-22) **Charge correlations in the breakup of gold projectiles in reactions at E/A=600 MeV.** Kreutz, P. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany); Frankfurt Univ. (Germany). Fachbereich 13 - Physik. Sep 1992. 136p. (In German). Order Number DE93744565. Source: OSTI; NTIS (US Sales Only); INIS.

In the present thesis the charge correlations in the breakup of gold projectiles in heavy ion collisions at an incident energy of E/A=600 MeV were studied. Thereby it has been proved that the sum of the charges from the projectile source under exclusion of the protons (Z_{bound}) is saliently suited for the classification of the nuclear reactions. At large values of Z_{bound} we fins fission and spallation reactions. For smaller values of Z_{bound} we observe events with an increasing number of medium-heavy fragments. Thereby the multifragment events appear in the Dalitz diagrams as a continuation of more symmetric becoming spallation events. In reactions with $Z_{bound} \simeq 35$ the conditions for the formation of medium-heavy fragments are optimal and the multifragment events

represent the dominating exit channel. A mean multiplicity of the medium-heavy fragments of $\simeq$ 4 is reached. (orig./HSI).

7003 (GSI–92-62(prepr.)) **Effect of angular-momentum dissipation and fluctuation on energy coherence lengths and time evolution in the dissipative collision $^{28}Si+^{48}Ti$.** Kun, S.Yu. (Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany)); Noerenberg, W.; Papa, M. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany). Sep 1992. 15p. Order Number DE93742799. Source: OSTI; NTIS (US Sales Only); INIS.

We analyze the energy autocorrelation functions and the energy coherence lengths in the strongly dissipative collision ^{28} Si(E_{lab} = 130 MeV) +^{48}Ti for Z=11 and 12 reaction fragments. It is found that in order to obtain a good fit of both the energy averaged angular distributions and the angular dependence of the energy coherence lengths one has to take into account (i) the dissipation and fluctuation of the relative angular momentum of the dinucleus and (ii) the contribution from direct (fast) reactions in addition to the statistical (relatively slow) interaction processes. The established angular dependence is a direct consequence of the angular-momentum dissipation-fluctuation effects on the time-space evolution of the intermediate dinucleus. (orig.).

7004 (INIS-BR–3031) **Study on elastic scattering of 412 KeV γ radiation in elements of different atomic numbers.** Goncalves, O.D. Universidade Federal, Rio de Janeiro, RJ (Brazil). Inst. de Fisica. 1977[65] (In Portuguese). Order Number DE93610063. Source: OSTI; NTIS (US Sales Only); INIS.

The differentials cross sections for elastic scattering of 412 KeV γ rays was measured with Ge-Li detectors for elements of z = 78, 74, 56, 48 and 47. For the elements of z 78, 56 and 48 don't exist former measurements, while for z 74 and 48 exist only measurements done with NaI detectors, of poor resolution. Approximated theories calculated through H.F.S.D. form factors are discussed. From the analysis of the experimental and theoretical results, anomalies early pointed in this approximation could be explained. The experimental results presented good agreement with recent theoretical calculations done with second order perturbation theory. (author).

7005 (INIS-BR–3112, pp. 133-174) **Subthreshold particle production in heavy-ion collisions.** Mosel, U. (Giessen Univ (Germany). Inst. fuer Theoretische Physik). Sociedade Brasileira de Fisica, Sao Paulo, SP (Brazil). 1991. [258] (CONF-9102193–: 5. Swieca School in Nuclear Physics, Campos do Jordao (Brazil), 19-28 Feb 1991). In *Proceedings of the 5. Swieca School in Nuclear Physics.* Order Number DE93609952. Source: OSTI; NTIS (US Sales Only); INIS.

Subthreshold production processes are discussed in the theoretical framework, checking data obtained from hard-photon production in the energy range from 20 to 100 MeV/u. The reactions at higher energies are described and the predictions for particle production cross sections are discussed. A particular attention to properties of hadrons (nucleons and mesons) in the nuclear medium is given. (M.C.K.).

7006 (INS–940) **Possibility of a crossed-beam experiment involving slow-neutron capture by unstable nuclei 'rapid-process-tron'.** Yamazaki, T.; Katayama, I.; Uwamino, Y. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Jul 1992. 14p. Order Number DE93754288. Source: OSTI; NTIS; INIS.

The possibility of a crossed beam facility of slow neutrons x unstable nuclei is examined in connection with the Japanese Hadron Project. With a pulsed proton beam of 50 Hz repetition with a 100 μA average beam current, one obtains a spallation neutron source of 2.4 x 10^8 thermal neutrons/cm^3/spill over a 60 cm length with a 3 msec average duration time by using a D_2O moderator. By confining radioactive nuclei of 10^9 ions in a beam circulation ring of 0.3 MHz revolution frequency, so that they pass through the neutron source, one obtains a collision luminosity of 3.9 x 10^{24}/cm^2/sec. A new research domain aimed at studying rapid processes in nuclear genetics at laboratory will be created. (author).

7007 (INS–941) **Double-lambda compound nucleus and the formation of double hypernuclei.** Yamazaki, Toshimitsu; Tamura, Hirokazu. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Jul 1992. 12p. Order Number DE93754289. Source: OSTI; NTIS; INIS.

The formation probabilities of single-Λ and double-Λ compound nuclei from Ξ^- following the (K^-, K^+) reaction are calculated, showing that double-Λ-hypernuclei are formed with a fairly large probability through a hyperon compound process involving Ξ^- directly after the (K^-, K^+) reaction. (author).

7008 (JAERI–1324) **Data Book for calculating neutron yields from (α, n) reaction and spontaneous fission.** Matsunobu, Hiroyuki (Sumitomo Atomic Energy Industries Ltd., Osaka (Japan)); Oku, Takeshi; Iijima, Shungo; Naito, Yoshitaka; Masukawa, Fumihiro; Nakasima, Ryuzo. Japan Atomic Energy Research Inst., Tokyo (Japan). Jan 1992. 268p. (In Japanese). Order Number DE93753275. Source: OSTI; NTIS; INIS.

Neutron yields from (α, n) reaction and spontaneous fission, which are very important in analyzing radiation shielding of spent fuel storage, transport, and safe handling, were collected and evaluated to determine the recommendable values. For thick target neutron yields from (α, n) reactions, the most accurate data of West and Sherwood, the newest evaluated data of Heaton et al., and the data of high atomic number nuclides evaluated by Nakasima were adopted. And the experimental data at a high energy region of Stelson and McGowan were also used as references. The data for estimating neutron yields of unmeasured elements are also prepared in this Data Book by using theoretical values of (α, n) excitation function and the evaluation formulas on stopping power by Ziegler. For neutron yields from spontaneous fission, the values recommended by S. Raman were mainly adopted. Neutron energy spectra of (α, n) reaction and spontaneous fission were also included in this Data Book. Neutron production data of compounds can be obtained by using the neutron yield and stopping power of each single element. (author).

7009 (JINR–7-46-90, pp. 36-45) **Grey particle distributions in high energy nucleus-nuclear collisions.** Hegab, M.K. (Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of High Energy); Sherif, M.M.; Krasnov, S.A.; Vokael, S. Joint Inst. for Nuclear Research, Dubna (Russian Federation). 1990. In *JINR rapid communications: Collection.* [77] Order Number DE93609511. Source: OSTI; NTIS (US Sales Only); INIS.

A simple analytic model for the description of grey (g) particle production (mostly recoil-target protons in the energy range of 26<E<400 MeV) in high energy nucleus-nuclear collisions is proposed. The model is parameter-free and its input information is the distribution of grey particles produced in proton-induced reactions. Good agreement with experimental multiplicity distributions and mean values of grey particles produced in heavy-ion Dubna emulsion experiments is obtained. 11 refs.; 2 figs.; 2 tabs.

7010 (JINR–7-46-90, pp. 19-26) **Inclusive π^0-meson production in $^{12}C+^{12}C \rightarrow \pi^0+X$ reaction at 4.5 GeV/c per nucleon momentum.** Abraamyan, Kh.U. (Erevanskij Gosudarstvennyj Univ., Erevan (Armenia)); Khudaverdyan, A.G.; Arkhipov, V.V.; Iz*yurov, V.M.; Meikumov, G.L.; Plyashkevich, S.N.; Khachaturyan, M.N. Joint Inst. for Nuclear Research, Dubna (Russian Federation). 1990. (In Russian). In *JINR rapid communications: Collection.* [77] Order Number DE93609511. Source: OSTI; NTIS (US Sales Only); INIS.

The cross section of π^0-meson inclusive production in $^{12}C+^{12}C \rightarrow \pi^0+X$ reaction at 4.5 GeV/c per nucleon momentum is measured depending on cumulative number X and the square of transverse momentum. Differential and invariant inclusive cross sections of CC $\rightarrow \pi^0$X reaction are calculated. The dependence of π^0-meson production cross section on the number of nucleons in an incident nucleus is measured for αC $\rightarrow \pi^0$X and CC $\rightarrow \pi^0$X reactions. 6 refs.; 6 figs.; 2 tabs.

7011 (JINR–7-46-90, pp. 27-35) **Comparative analysis of the processes of kaon and Λ hyperon production in nucleus-nuclear collisions.** Iovchev, K. (Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of High Energy); Kladnitskaya, E.N.; Okonov, Eh.O. Joint Inst. for Nuclear Research, Dubna (Russian Federation). 1990. (In Russian). In *JINR rapid communications: Collection.* [77] Order Number DE93609511. Source: OSTI; NTIS (US Sales Only); INIS.

An analysis is made to compare the characteristics of K_S^0 mesons and Λ hyperons produced in CC, CNe and ONe interactions at energies E_p=3.4 - 3.7 AxGeV. The analysis shows that the angular distributions for K_S^0 mesons (as well as for Λ hyperons) become more uniform, approaching the isotropic ones at E≈30 GeV, with increasing the number of nucleon-participants of the projectile, i.e. with increasing their total energy. The revealed regularities agree with the expected signatures predicted by QCD thermodynamics for the first-order phase transition with the formation on mixed phase of quark-gluon and hadron plasma. 20 refs.; 3 figs.

7012 (JINR-R–1-91-495) **Study of secondary neutron production in π^--Xe-interactions at 3.5 GeV/c.** Bekmirzaev, R.N. (Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of High Energy); Grishin, V.G.; Ibatov, R.M.; Muminov, M.M.; Sultanov, M.U.; Sharipova, S.A.; Miller, K.; Tas, P. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of High Energy. 1991. [7] (In Russian). Order Number DE93610076. Source: OSTI; NTIS (US Sales Only); INIS.

The analysis of multiplicity momentum and angular characteristics of neutrons and protons in π^--interactions with Xenon nucleus at 3.5 GeV/c is carried out. It is shown that the average characteristics for neutrons are systematically higher than for protons produced in inelastic π^-Xe collisions at 3.5 GeV/c. The experimental results are compared with the infranuclear cascade model. 9 refs.; 2 figs.; 2 tabs.

7013 (KFTI–90-12) **Possibility of neutron electric form factor etermination in the d-vector(e,e'p-vector)n reaction.** Gakh, G.I. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. [20] (In Russian). Order Number DE93610074. Source: OSTI; NTIS (US Sales Only); INIS.

The polarization of protons produced in the vector-polarized deuteron disintegration by unpolarized electrons has been analyzed. The sensitivities of the polarization observation to the neutron electric form factor G_{en} and also to different parametrizations of the deuteron wave functions (DWF) have been investigated in the framework of the relativistic impulse approximation. The present method of the G_{en} determination does not require the use of the longitudinally polarized electron beams. 34 refs.; 9 figs.

7014 (LA–12441-MS) **Ice targets for use at NTOF.** Mercer, D.J. Los Alamos National Lab., NM (United States). Dec 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE93004055. Source: OSTI; NTIS; INIS; GPO Dep.

This report describes ice targets which were used during an experiment at the Neutron Time of Flight facility (NTOF) at LAMPF. Reasons for using the ice targets are given, and the construction, refrigeration system, and target preparation are detailed. Results of the research using these ice targets will be published at a later date.

7015 (LA-UR–92-3241) **Flavor flow in ultrarelativistic nucleus-nucleus collisions: The RQMD approach: Final report.** Sorge, H. (Los Alamos National Lab., NM (United States)); Berenguer, M.; Jahns, A.; Winckelmann, L.; Mattiello, R.; Schoenfeld, T.; Stoecker, H.; Greiner, W. Los Alamos National Lab., NM (United States). [1992]. 42p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-920777–3: NATO advanced study institute on particle production in highly excited matter, Ciocco (Italy), 12-25 Jul 1992). Order Number DE93003689. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses relativistic quantum molecular dynamics; baryon number flow; strangeness; antibaryon annihilation; and dilepton emission.

7016 (LA-UR–92-3404) **Model cross section calculations using LAHET.** Prael, R.E. Los Alamos National Lab., NM (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-921046–11: Symposium on nuclear data evaluation methodology, Upton, NY (United States), 12-16 Oct 1992). Order Number DE93003727. Source: OSTI; NTIS; INIS; GPO Dep.

The current status of LAHET is discussed. The effect of a multistage preequilibrium exciton model following the INC is examined for neutron emission benchmark calculations, as is the use of a Fermi breakup model for light nuclei rather than an evaporation model. Comparisons are made also for recent fission cross section experiments, and a discussion of helium production cross sections is presented.

7017 (LA-UR–92-3417) **Use of the nuclear model code GNASH to calculate cross section data at energies up to 100 MeV.** Young, P.G.; Chadwick, M.B.; Bosoian, M. Los Alamos National Lab., NM (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-921046–12: Symposium on nuclear data evaluation methodology, Upton, NY (United States), 12-16 Oct 1992). Order Number DE93003723. Source: OSTI; NTIS; INIS; GPO Dep.

The nuclear theory code GNASH has been used to calculate nuclear data for incident neutrons, protons, and deuterons at energies up to 100 MeV. Several nuclear models and theories are important in the 10–100 MeV energy range, including Hauser-Feshbach statistical theory, spherical and deformed optical model, preequilibrium theory, nuclear level densities, fission theory, and direct reaction theory. In this paper we summarize general features of the models in GNASH and describe the methodology utilized to determine relevant model parameters. We illustrate the significance of several of the models and include comparisons with experimental data for certain target materials that are important in applications.

7018 (LA-UR–92-3762) **Sensitivity of fission-product neutron absorption to ENDF/B-IV, -V, and -VI nuclear data parameters.** Wilson, W.B.; England, T.R.; George, D.C. Los Alamos National Lab., NM (United States). [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9205198–5: Organization for economic cooperation and development, Nuclear Energy Agency Nuclear Science Committee (NEANSC) specialists' meeting on fission product nuclear data, Tokai-mura (Japan), 25-27 May 1992). Order Number DE93003830. Source: OSTI; NTIS; INIS; GPO Dep.

A comprehensive study of fission-product neutron absorption in LWR fuel was made by us in the past with ENDF/B-IV data. We identified the nuclides significantly contributing to total fission-product neutron absorption in the fuel at any time during a 33 GWd/tU exposure history. Some 291 parameters strongly affecting the production of these nuclides were identified and individually perturbed in a study of the sensitivity of fission-product absorption to these data. The data to which sensitivities were the greatest at three exposures were identified, forming a superset of nuclear data parameters to which fission-product absorption is most sensitive. We now examine the effect on fission-product neutron absorption resulting from changes in these data as we have progressed from ENDF/B-IV to ENDF/B-V to ENDF/B-VI and, for yields, to the new release of ENDF/B-VI yield data described separately at this meeting.

7019 (LA-UR–92-3806) **A new region for fission and fission isomer studies.** Wilhelmy, J.B.; Moeller, P. Los Alamos National Lab., NM (United States). [1992]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9210121–1: Workshop on the production and use of intense radioactive ion beams for the IsoSpin Laboratory, Oak Ridge, TN (United States), 7-10 Oct 1992). Order Number DE93003842. Source: OSTI; NTIS; INIS; GPO Dep.

Short communication. FISSION; FISSION ISOMERS; FISSION; ISOSPIN; BINDING ENERGY; RADON ISOTOPES; RADIUM ISOTOPES; ION BEAMS; RADIOACTIVITY

7020 (LBL–32812) **Charged particle spectra in ^{32}S + ^{32}S interactions at 200 GeV/nucleon from CCD-imaged nuclear collisions in a streamer chamber.** Teitelbaum, L.P. Lawrence Berkeley Lab., CA (United States). Apr 1992. 208p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE93002562. Source: OSTI; NTIS; INIS; GPO Dep.

We have measured the transverse momentum spectra $1/p_T$ dN/dp_T and rapidity distributions dN/dy of negatively charged hadrons and protons for central ^{32}S + ^{32}S interactions at 200 GeV/nucleon incident energy. The negative hadron dN/dy distribution is too broad to be accounted for by thermal models which demand

isotropic particle emission. It is compatible with models which emphasize longitudinal dynamics, by either a particle production mechanism, as in the Lund fragmentation model, or by introducing one-dimensional hydrodynamic expansion, as in the Landau model. The proton dN/dy distribution, although showing no evidence for a peak in the target fragmentation region, exhibits limited nuclear stopping power. We estimate the mean rapidity shift of participant target protons to be $\Delta y \sim 1.5$, greater than observed for pp collisions, less than measured in central pA collisions, and much less than would be observed for a single equilibrated fireball at midrapidity. Both the negative hadron and proton dN/dy distributions can be fit by a symmetric Landau two-fireball model. Although the spectrum possesses a two-component structure, a comparison to pp data at comparable center-of-mass energy shows no evidence for enhanced production at low p_T. The two-component structure can be explained by a thermal and chemical equilibrium model which takes into account the kinematics of resonance decay. Using an expression motivated by longitudinal expansion we find the same temperature for both the protons and negative hadrons at freezeout, $T_f \sim 170$ MeV. We conclude that the charged particle spectra of negative hadrons and protons can be accommodated in a simple collision picture of limited nuclear stopping, evolution through a state of thermal equilibrium, followed by longitudinal hydrodynamic expansion until freezeout.

7021 (LUNFD6-NFFK–7131/1992) **On intermittency in heavy ion collisions and the importance of γ-conversion in a multi-dimensional intermittency analysis.** Adamovich, M.I. (Lebedev Inst., Moscow (Russian Federation)); Alexandrov, Y.A.; Aggarwal, M.M. EMU01-collaboration. Lund Univ. (Sweden). Dept. of Cosmic and Subatomic Physics. Mar 1992. [46] (LUIP–9202.). Order Number DE93610093. Source: OSTI; NTIS; INIS.

Non-statistical fluctuations are used to probe the dynamical behaviour of multiparticle production in heavy ion interactions at ultra-relativistic energies. In a one-dimensional analysis a $1/\rho$-scaling is established and it is furthermore found that effects from higher order particle correlations are small. In a two-dimensional analysis it is shown that a small background of particle-pairs with a narrow opening angle can distort the observed signal. As an example we estimate of the influence of γ-conversion and find that in our experiment γ-conversion alone gives results consistent with the experimental observations from a two-dimensional analysis. Whereas a two-dimensional analysis filters events where two particles are extremely close in phase space, the one-dimensional analysis picks out events with particles clustered in pseudorapidity, which are at the same time diluted in the azimuthal plane. (au).

7022 (LUNFD6-NFFK–7132/1992) **Local particle densities and global multiplicities in central heavy ion interactions at 3.7, 14.6, 60 and 200 A GeV.** Adamovich, M.I. (Lebedev Inst., Moscow (Russian Federation)); Alexandrov, Y.A.; Aggarwal, M.M. EMU01-collaboration. Lund Univ. (Sweden). Dept. of Cosmic and Subatomic Physics. Mar 1992. [28] (LUIP–9203.). Order Number DE93610094. Source: OSTI; NTIS; INIS.

The energy and centrality dependence of local particle pseudorapidity densities as well as validity of various parametrizations of the distributions are examined. The dispersion, σ, of the rapidity density distribution of produced particles varies slowly with centrality and is 0.80, 0.98, 1.21 and 1.41 for central interactions at 3.7, 14.6, 60 and 200 A GeV incident energy, respectively. σ is found to be independent of the size of the interacting system at fixed energy. A novel way of representing the window dependence of the multiplicity as normalized variance versus inverse average multiplicity is outlined. (au).

7023 (NIFS-DATA–15) **Compilation of excitation cross sections for He atoms by electron impact.** Kato, T.; Itikawa, Y.; Sakimoto, K. National Inst. for Fusion Science, Nagoya (Japan). Mar 1992. 98p. Order Number DE93753246. Source: OSTI; NTIS; INIS.

Experimental and theoretical data are compiled on the cross section for the excitation of He atoms by electron impact. The available data are compared graphically. The survey of the literature has been made through the end 1991. (author).

7024 (PTB-N–8) **Investigation of the ^{9}Be(a,n)^{12}C reaction. Pt. 2. Differential cross sections for E_a=7.02-15.70 MeV and $E_{ex}(^{12}C)$=0.0, 4.439, 7.654, 9.641, 10.84, 11.83 and 12.71 MeV.** Schmidt, D.; Boettger, R.; Klein, H.; Nolte, R. Physikalisch-Technische Bundesanstalt, Braunschweig (Germany). Apr 1992. 96p. Order Number DE93742733. Source: OSTI; NTIS (US Sales Only); INIS.

Differential cross sections of the ^{9}Be(α,n)^{12}C reaction have been measured at 19 alpha energies between 7 MeV and 16 MeV. Besides the differential cross sections from the ^{9}Be(α,n)^{12}C(g.s.) reaction, also those of the ^{9}Be(α,n)^{12}C(E_{ex}) reactions were derived for excitation energies E_{ex} = 4.439, 7.654, 9.641, 10.84, 11.83 and 12.71 MeV. Possible sources of uncertainties have been extensively investigated and the corresponding results have been published in part 1. All partial and integrated cross sections from the ^{9}Be(α,n)^{12}C(g.s.) reaction were determined with uncertainties of less than 5%. The angular distributions were fitted to Legendre polynomial expansions by the least-squares method. A comparison of the measured cross sections with data from other authors and with an evaluation shows considerable deviations in some cases. Tests were also carried out to ascertain how well an interpolation of the Legendre coefficients reproduces the magnitude and shape of the experimentally determined angular distributions. All angular distributions are presented in figures, together with their Legendre polynomial expansions and data from the literature if available. The a_l coefficients of the Legendre polynomial expansions are given in the Appendix. (orig.).

7025 (RAL–92-038) **Heavy-ion collisions and a new phase of QED.** Papageorgiu, E. Rutherford Appleton Lab., Chilton (United Kingdom). Jun 1992. [13] Order Number DE93610095. Source: OSTI; NTIS (US Sales Only); INIS.

We argue that the "anomalous" narrow peaks, seen in the e^+e^- spectrum of heavy-ion collisions, at energies near the Coulomb barrier, may be due to the fact that the effective coupling of the e^+e_- system to the coherent electromagnetic EM-field of the two nuclei, can be of order one at impact parameters comparable (or smaller) to the e^- Compton wavelength. It is conceivable that the excitation of a large number of virtual and real pairs within a Compton volume could result in momentum correlations for the e^+ and e^-, or even lead to a "new phase" of quantum electrodynamics (QED) with a different mass scale for the electron. The presence of similar anomalies in the e^+e^- spectrum of relativistic, but exclusively coherent, collisions of heavy nuclei, would support this idea and rule out any interpretation based on spontaneous emission from a supercritical QED vacuum. In addition, the use of e^+e^- interferometry could help in clarifying the crucial point of whether the emitted pairs stem from a new or the well-known phase of QED. (author).

7026 (RCNP-P–120) **Report of the workshop on 'light particle-induced reactions'.** Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics. 1992. 330p. (In Japanese). (CONF-9112148–: Workshop on 'light particle-induced reactions', Osaka (Japan), 5-7 Dec 1991). Order Number DE93752300. Source: OSTI; NTIS; INIS.

The study meeting on light particle (mass number = 3 - 11)-induced reation was held for three days from December 5 to 7, 1991 at the Research Center for Nuclear Physics, Osaka University. This book records the report based on the lectures presented at the meeting. In the new facility of the RCNP, the experiment on the nuclear reaction using 400 MeV polarized protons and 200 MeV polarized deuterons is about to begin. When the acceleration of polarized He-3 beam which is being developed at present becomes feasible, by combining it with the high resolution spectrometer GRAND RAIDEN, it is expected that the unique, high accuracy research using the polarized He-3 having intermediate energy (540 MeV) becomes possible. At this time, by focusing attention to what new physics is developed by the nuclear reaction induced by the composite particles having the intermediate energy of mass number 3 - 11, this study meeting was planned and held. As the results, 29 lectures collected in this book were to cover wide fields, and active discussion was carried out. (K.I.).

7027 (SAND–92-1843C) **Screened Rutherford backscattering cross section for heavy ion and low energy backscattering analysis.** Lee, S.R. (Sandia National Labs., Albuquerque, NM

(United States)); Hart, R.R. Sandia National Labs., Albuquerque, NM (United States). [1992]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-921116–7: 12. international conference on the application of accelerators in research and industry, Denton, TX (United States), 2-5 Nov 1992). Order Number DE93002484. Source: OSTI; NTIS; INIS; GPO Dep.

The energy dependence of the total differential scattering cross-section of 20-180 keV H^+, D^+ and He^+ ions, as well as 100-350 keV C^{++} and O^{++} ions, backscattered through a laboratory angle of 161.2° by monolayer-thick Au targets was measured. The ratio of the measured cross section to the Rutherford cross section ranged from 0.91 for 180 keV H^+ to 0.44 for 100 keV O^{++}. The results were found to be in excellent agreement with exact classical calculations of the scattering cross section performed using Dirac-Fock atomic potentials. A comprehensive review of all previous measurements of the screened Rutherford backscattering cross section has been performed for comparison with the present results.

7028 (UM-P–92/29) **Hypernuclear reactions in carbon 12.** Koetsier, D.; Amos, K. Melbourne Univ., Parkville, VIC (Australia). School of Physics. [1992]. [24] Order Number DE93610120. Source: OSTI; NTIS (US Sales Only); INIS.

Shell model calculations of the structure of ^{12}C have been made using diverse potential energy sets based upon the Nijmegen one boson exchange models of the hyperon-nucleon interaction. Transition density matrix elements for excitation of low lying hypernuclear states by strangeness changing reactions upon ^{12}C have been extracted and used in analyses of (K^-,π^-) and (π^+,K^+) cross sections. Successful fits to data have been obtained using an Analytic Distorted Wave Approximation for the scattering amplitudes. 13 refs., 1 tab., 7 figs.

7029 (UM-P–92/56) **Research report to the Gordon conference on photonuclear reactions.** Melbourne Univ., Parkville, VIC (Australia). School of Physics. [1992]. [10] (CONF-9208151–: Gordon conference on photonuclear reactions, Tilton, NH (United States), 10 Aug 1992). Order Number DE93610064. Source: OSTI; NTIS (US Sales Only); INIS.

An experimental program has been carried out using the facilities at the Laboratory of Nuclear Science of Tohoku University, and at Saskatchewan University. This report summarises the current progress in studies at energies up to 100 MeV, and lists recently published papers.

7030 (UM-P–92/56, pp. 1-2) **The angular distribution of $^{16}O(\gamma,p_0)$ and $^{16}O(\gamma,p_{123})$ cross sections for E_γ = 35 MeV to 100 MeV.** Bates, A.D. (Melbourne Univ., Parkville (Australia). School of Physics); McLean, D.J.; O'Keefe, G.J.; Rassool, R.P.; Thompson, M.N.; Ito, S.; Kono, O.; Suda, T.; Sugawara, Y.; Terasawa, T. Melbourne Univ., Parkville, VIC (Australia). School of Physics. [1992]. (CONF-9208151–: Gordon conference on photonuclear reactions, Tilton, NH (United States), 10 Aug 1992). In *Research report to the Gordon conference on photonuclear reactions.* [10] Order Number DE93610064. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. 2 refs., 1 fig. OXYGEN 16 TARGET/cross sections; OXYGEN 16 TARGET/photonuclear reactions; ANGULAR DISTRIBUTION; ENERGY DEPENDENCE; EXPERIMENTAL DATA; MEV RANGE 10-100; PROTONS; TAGGED PHOTON METHOD

7031 (UM-P–92/56, pp. 2-3) **High resolution measurement of the $^{16}O(\gamma,p)^{15}N$, $^{16}O(\gamma,n)^{15}O$ and $^{16}O(\gamma,pn)^{14}N$ reactions.** Sims, D.A. (Melbourne Univ., Parkville (Australia). School of Physics); O'Keefe, G.J.; Rassool, R.P.; Bates, A.D.; Thompson, M.N.; Ito, S.; Sazaki, S.; Konno, O.; Terasawa, T.; Suda, T.; Maeda, K. Melbourne Univ., Parkville, VIC (Australia). School of Physics. [1992]. (CONF-9208151–: Gordon conference on photonuclear reactions, Tilton, NH (United States), 10 Aug 1992). In *Research report to the Gordon conference on photonuclear reactions.* [10] Order Number DE93610064. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. 2 refs., 1 fig. OXYGEN 16 TARGET/photonuclear reactions; OXYGEN 16 TARGET/quantum chromodynamics; CROSS SECTIONS; ENERGY DEPENDENCE; EXPERIMENTAL DATA; MEV RANGE 10-100; NEUTRONS; NITROGEN 14; NITROGEN 15; OXYGEN 15; PROTONS; RESOLUTION; TAGGED PHOTON METHOD

7032 (UM-P–92/56, pp. 4-5) **Measurement of the ^4He photoneutron cross section.** McLean, D.J. (Melbourne Univ., Parkville (Australia). School of Physics); Bates, A.D.; Rassool, R.P.; Thompson, M.N.; Maeda, K.; Suda, T.; Konno, O.; Nomura, I.; Sugawara, Y.; Terasawa, T. Melbourne Univ., Parkville, VIC (Australia). School of Physics. [1992]. (CONF-9208151–: Gordon conference on photonuclear reactions, Tilton, NH (United States), 10 Aug 1992). In *Research report to the Gordon conference on photonuclear reactions.* [10] Order Number DE93610064. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. 5 refs., 1 fig. HELIUM 4 TARGET/photonuclear reactions; PHOTONUCLEAR REACTIONS/differential cross sections; EXPERIMENTAL DATA; HELIUM 3; MEV RANGE 10-100; NEUTRONS; TAGGED PHOTON METHOD

7033 (UM-P–92/56, pp. 6) **$^{16}O(\gamma,N)$, $^{16}O(\gamma,NN)$ reaction cross sections for 35 MeV < E_γ <105 MeV.** O'Keefe, G.J. (Melbourne Univ., Parkville (Australia). School of Physics); Bates, A.D.; Rassool, R.P.; McLean, D.J.; Thompson, M.N.; Terasawa, T.; Sugawara, M. Melbourne Univ., Parkville, VIC (Australia). School of Physics. [1992]. (CONF-9208151–: Gordon conference on photonuclear reactions, Tilton, NH (United States), 10 Aug 1992). In *Research report to the Gordon conference on photonuclear reactions.* [10] Order Number DE93610064. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. 3 refs., 1 fig. OXYGEN 16 TARGET/differential cross sections; OXYGEN 16 TARGET/photonuclear reactions; PHOTONUCLEAR REACTIONS/angular correlation; EXPERIMENTAL DATA; MEV RANGE 10-100; TAGGED PHOTON METHOD

6635 Nuclear Mass Ranges

Refer also to citation(s) 6181, 6403, 6926, 6962, 6964, 6965, 6967, 6972, 6973, 6974, 6976, 6977, 6978, 6979, 6980, 6982, 6986, 6988, 6992, 6993, 6994, 6996, 6997, 6998, 6999, 7000, 7001, 7002, 7003, 7010, 7011, 7012, 7020, 7023, 7024, 7027, 7028, 7030, 7031, 7032, 7033

6636 Radiation Physics

Refer also to citation(s) 5168, 5443, 5446, 5447, 5451, 6052, 6424, 6426, 7008, 7094, 7099, 7116, 7462, 7463, 7479

7034 (ANL/EP/CP–77833) **Basic concepts underlying fast-neutron-based contraband interrogation technology: A systems viewpoint.** Fink, C.L.; Guenther, P.T.; Smith, D.L. Argonne National Lab., IL (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9210215–2: Contraband and cargo inspection technology, Washington, DC (United States), 28-30 Oct 1992). Order Number DE93004153. Source: OSTI; NTIS; INIS; GPO Dep.

All accelerator-based fast-neutron contraband interrogation systems have many closely interrelated subsystems, whose performance parameters will be critically interdependent. For optimal overall performance, a systems analysis design approach is required. This paper provides a general overview of the interrelationships and the tradeoffs to be considered for optimization of nonaccelerator subsystems.

7035 (CONF-8909210–, pp. 9-14) **Electromagnetic resonances in self similar arrays of particles or voids.** Claro, F. (Pontificia Univ. Catolica de Chile, Santiago (Chile)); Fuchs, R. Oak Ridge National Lab., TN (United States). Apr 1990. DOE Contract W-7405-ENG-82. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

It is well known that a variety of surface and bulk inhomogeneities can be well described by self similar models. These models are constructed so that through several stages of amplification the

details in the structure have the same geometrical features. The dielectric response of a self similar cluster of metallic particles or random array of voids is considered. The response function obeys a recursive relation that yields a self similar distribution of modes. Their strength is also found to exhibit self similar properties.

7036 (CONF-8909210–, pp. 69-83) **Stopping power for protons in Al for the whole range of velocities.** Flores, F. (Univ. Autonoma de Madrid (Spain)); Arnau, A.; Echenique, P.M.; Ritchie, R.H. Oak Ridge National Lab., TN (United States). Apr 1990. DOE Contract AC05-84OR21400. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

The electronic stopping power of aluminum metal for protons has been calculated with explicit inclusion of the different proton charge states inside the medium. The total stopping power is obtained by adding to the calculated stopping power of each charge state, the energy loss associated with the electronic exchange processes. Good agreement is obtained between the first principles calculation and the available experimental data.

7037 (CONF-8909210–, pp. 85-100) **Stopping power of protons revisited.** Lapicki, G. (East Carolina Univ., Greenville, NC (United States)). Oak Ridge National Lab., TN (United States). Apr 1990. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

The low-velocity stopping power formula of Lindhard and Scharff (1961) was rederived; when scaled with a different definition of the TF unit of length for the projectile-target quasimolecule, it agreed with the semiempirical fits of Andersen and Ziegler (1977) up to $v_1 = 2/3$ - the agreement was no worse than seen in previous comparisons of these fits with the calculations of Echenique et al. (1981, 1986). Bethe's high-velocity stopping power was employed with a semitheoretical function for the average ionization potential - this function was constructed to equal 15 eV for hydrogen. The Andersen-Ziegler fits were found to converge to this high-velocity formula; measurements with GeV-protons stopped in the lightest targets are needed to verify the universal utility of Bethe' stopping power in the high-velocity limit. Further work in progress will search for an expedient but more justified (if not simpler) L for all proton velocities.

7038 (CONF-8909210–, pp. 101-109) **Stopping power theory in inhomogeneous many electron systems.** Kitagawa, M. (North Shore Coll., Atugi (Japan)). Oak Ridge National Lab., TN (United States). Apr 1990. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

A dielectric function ε for an inhomogeneous many-electron gas was obtained analytically as the first order formula under the condition of the high frequency response. Using the lowest order of approximation in an iteration for the integral equation of ε^{-1}, the author also showed that the lowest order formula of stopping power exactly corresponds to one called as the local density approximation (LDA). In this paper, the author derives the integral formula of stopping power for the system, in which the electron density changes one-dimensionally. Such a kind of formula is applied to the problem of the solid surface.

7039 (CONF-8909210–, pp. 125-138) **Variational approach to the scattering theory and its application in stopping phenomena.** Apagyi, B. (Technical Univ. of Budapest (Hungary)); Nagy, I. Oak Ridge National Lab., TN (United States). Apr 1990. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

The spurious singularities arising in the Kohn and Schwinger variational methods (applicable, e.g., to the calculation of quantum reactive scattering of atomic systems) can be avoided by using a particular least-squares procedure referred to as Ladanyi variational method. With the aid of the latter method, phase shifts of very high accuracy can be computed for low energy electron scattering by impurities. Some simple one- and two-parameter models are presented for proton and anti-proton stopping by an electron gas. The models fulfill Kato's cusp condition and/or Friedel's sum rule.

7040 (CONF-8909210–, pp. 239-254) **Wake-riding electrons emitted by antiprotons traversing solid targets.** Burgdoerfer, J. (Univ. of Tennessee, Knoxville (United States)); Wang, J.; Mueller, J. Oak Ridge National Lab., TN (United States). Apr 1990. DOE Contract AC05-84OR21400. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

The dielectric response of the medium to a swift ion induces collective charge-density fluctuations which result in an oscillatory polarization potential trailing the ion (wake). The concept of such a wake dates back to Bohr. The first quantitative treatment of the dynamical screening potential around an ion was pioneered by Neufeld and Ritchie. Meanwhile, a large number of investigations implementing approximations at various levels of sophistication have been performed. The plasmon-pole approximation is one of the simplest approximation which still accounts qualitatively for most of the features of the wake. Clearly, more subtle effects like bow waves and other dispersion effects are neglected. The authors will restrict themselves in the following to the plasmon-pole approximation including a phenomenological damping. They also neglect in the following effects of the self-wake which can affect the shape of the wake potential. Recently, the experimental study of wake-riding electrons accompanying antiproton transmission through carbon foils using the Low Energy Antiproton Ring facility at CERN has been proposed. First experiments are presently underway. The authors have performed a theoretical study to explore the possible existence of a peak of wake-riding electrons accompanying antiprotons. Two important features to be discussed in detail below make their observation in the forward-electron spectrum for antiprotons more likely than in the spectrum for positively charged ions: (a) the well-known cusplike enhancement in the forward spectrum of positively charged particles is absent, thereby facilitating the observation of wake-riding electrons which appear in the same region of the spectrum, and (b) the wake-riding states are localized a factor of ~ 3 closer to an antiproton than to a proton of the same speed. Electron capture probabilities into wake-riding states are therefore dramatically enhanced.

7041 (CONF-8909210–, pp. 449-475) **Orbital local plasma calculation of mean excitation energies and stopping numbers.** Trickey, S.B. (Univ. of Florida, Gainesville (United States)); Meltzer, D.E.; Sabin, J.R. Oak Ridge National Lab., TN (United States). Apr 1990. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

The extension of the Oddershede-Sabin orbitally-decomposed form of the kinetic theory of stopping from gas phase to films and crystals necessitates the generation of orbital mean excitation energies calculated within the local spin density approximation (LSDA) to density functional theory (DFT), the preeminent theoretical model for such extended systems. In LSDA, the Kohn-Sham (KS) orbitals and orbital eigenvalues are simply artifacts for the construction of the electron density ρ. They have no rigorous validity for estimation or calculation of excitation energies. As an alternative the authors present an orbital-density or local-density-of states generalization of the Lindhard-Scharff Local Plasma Approximation (LPA). They test the scheme via systematic study of mean excitation energies I_{ni} for each atomic central field orbital for all atoms with $Z < 37$. Stopping cross-sections for a representative sample (about half) of these elements have been calculated using these I_k values. They report four which illustrate their findings: O,

Al, Ar, and Ca. The results do not differ substantially from those of Oddershede and Sabin (who used l_n values obtained from work of Inokuti and co-workers), with the discrepancy generally less than 15%. Comparison of the LPA and OS orbital mean excitation energies exhibits a number of striking but difficult to interpret systematic features. Although the two methods give very different l_n's for core orbitals, there is little effect on the resulting stopping cross sections because the valence orbital l_n predominates at lower projectile energies and the inverse square velocity dependence of the stopping overwhelms moderate differences in l_n's at high velocities.

7042 (CONF-8909210–, pp. 595-613) **The theory of track formation in insulators due to densely ionizing particles.** Ritchie, R.H. (Oak Ridge National Lab., TN (United States)); Gras-Marti, A.; Ashley, J.C. Oak Ridge National Lab., TN (United States). Apr 1990. DOE Contract AC05-84OR21400. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

The energy lost in a solid by an ion with speed $v > v_0 = e^2/\hbar = 2.2 \times 10^8$ cm/s goes primarily into electronic excitation. However, in insulators the final result is a fairly well-defined track of displaced atoms about the path of the ion as well as associated atomic sputtering from proximate surfaces. To account for this phenomenon it has been proposed that Coulomb repulsion among residual ions in the core region may account for atomic displacement and track registration. However, a detailed and quantitative explanation has not been given, although some aspects of this mechanism have been discussed qualitatively. It has been assumed that electrons ejected from the core region are captured at appreciable distances from it, allowing Coulomb-driven expansion of the positively charged residual ions to take place. But the mechanism for this capture process is not at all clear. The authors have devised a self-consistent scheme for modeling the evolution of the electrons and ions created along the track of a swift, densely ionizing particle passing through an insulator. Numerical implementation of the model has been made.

7043 (DOE/ER/12818–2) **Improved deterministic calculational methods for irregularly shaped shields: Final report, September 30, 1988–November 30, 1990.** Dorning, J.J. Virginia Univ., Charlottesville, VA (United States). Dept. of Mechanical, Aerospace and Nuclear Engineering. Dec 1992. 41p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG07-88ER12818. (UVA–527390/MANE93/102). Order Number DE93004955. Source: OSTI; NTIS; INIS; GPO Dep.

A new discrete nodal transport method has been developed for general two-dimensional curvilinear geometry by using a boundary-fitted coordinate transformation from the general 'physical' coordinates to square 'computational' coordinates. The metrics which appear in the transformed transport equation are expanded using a simple polynomial function, and the angular divergence term is treated in the same way it is treated in S_N methods for curved geometries. Because the metrics of the transformation depend upon the computational coordinates, the technical details of the formal development of the nodal method differ from those of ordinary nodal methods for rectangular geometry. However, the computational process in the transformed rectangular coordinate system is very similar to that used in conventional discrete nodal transport methods. A discrete S_N method also has been developed to solve the boundary-fitted coordinate transformed transport equation. Simple test problems for non-simple geometries were solved using the zeroth-order nodal method, the first-order nodal method, and the S_N method for the same physical and computational grids. The results for the test problems studied showed that, for most performance criteria, the computational efficiency of the zeroth-order nodal method was the highest of the three methods.

7044 (IAEA-R–5147-F) **Gamma-ray production cross-sections for the interactions of 14.9 MeV neutrons with Si, Cu, Nb and Pb: Final report for the period 15 July 1988 - 15 December 1991.** Fan Guoying (Beijing Normal Univ., BJ (China). Inst. of Low Energy Nuclear Physics). International Atomic Energy Agency, Vienna (Austria). Dec 1991. [24] Order Number DE93610127. Source: OSTI; NTIS (US Sales Only); INIS.

Gamma rays produced in the interactions of 14.9 MeV neutrons with Si, Cu, Nb and Pb targets were studied. The neutron beam was produced with the T(d,n)He reaction using 300 KeV Cockroft-Walton accelerator. Absolute neutron flux was determined by the associated particle technique. The time-of-flight technique was used to reduce the background. The FWHM of neutron pulses was 1.5 ns. A Ge(Li) detector was used for gamma-ray detection. 39 gamma lines for Si, 39 gamma lines for Cu, 79 for Nb and 39 for Pb were detected. Most of these gamma rays were emitted in (n,γ), (n,n') and (n,2n) reactions. The measurements were made at 40 deg. C, 55 deg. C, 125 deg. C and 140 deg. C relative to the incident neutron beam. The results are presented in the form of the data tables. 9 refs, 11 figs, 19 tabs.

7045 (IEN–23/91) **A spectral nodal method for discrete ordinates problems in x,y geometry.** Barros, R.C. de (Instituto de Engenharia Nuclear (IEN), Rio de Janeiro, RJ (Brazil)); Larsen, E.W. Instituto de Engenharia Nuclear (IEN), Rio de Janeiro, RJ (Brazil). Jun 1991. [22] (In Portuguese). Order Number DE93610128. Source: OSTI; NTIS (US Sales Only); INIS.

A new nodal method is proposed for the solution of S_N problems in x- y-geometry. This method uses the Spectral Green's Function (SGF) scheme for solving the one-dimensional transverse-integrated nodal transport equations with no spatial truncation error. Thus, the only approximations in the x, y-geometry nodal method occur in the transverse leakage terms, as in diffusion theory. We approximate these leakage terms using a flat or constant approximation, and we refer to the resulting method as the SGF-Constant Nodal (SGF-CN) method. We show in numerical calculations that the SGF-CN method is much more accurate than other well-known transport nodal methods for coarse-mesh deep-penetration S_N problems, even though the transverse leakage terms are approximated rather simply. (author).

7046 (INIS-BR–3063) **Neutron wave reflexions in interface media with transport equation P_1 approximation.** Oliveira Vellozo, S. de. Instituto de Pesquisas Espaciais (INPE), Sao Jose dos Campos, SP (Brazil). 1977[72] (In Portuguese). Order Number DE93610129. Source: OSTI; NTIS (US Sales Only); INIS.

The propagation of neutron waves in non multiplying media is investigated employing the Telegrapher's equation obtained from the P_1 approximation of the time, space and energy dependent Boltzmann equation. Solution of the problem of propagation of sinusoidally modulated source incident on one face of the medium is obtained by analysing the Fourier component of a pulsed source introduced, for the corresponding frequency. The amplitude and the phase of the flux are computed as a function of frequency in media consisting of one, two and three regions in order to study the effects of reflection at the interfaces. The results are compared with those from the Diffusion approximation obtained by neglecting the term involving the second order time derivative. (author).

7047 (INIS-mf–13391) **Application of synthetic diffusion method in the numerical solution of the equations of neutron transport in slab geometry.** Valdes Parra, J.J. Instituto Politecnico Nacional, Mexico City (Mexico). Escuela Superior de Fisica y Matematicas. 1986[218] (In Spanish). Order Number DE93610130. Source: OSTI; NTIS (US Sales Only); INIS.

One of the main problems in reactor physics is to determine the neutron distribution in reactor core, since knowing that, it is possible to calculate the rapidity of occurrence of different nuclear reaction inside the reactor core. Within different theories existing in nuclear reactor physics, is neutron transport the one in which equation who govern the exact behavior of neutronic distribution are developed even inside the proper neutron transport theory, there exist different methods of solution which are approximations to exact solution; still more, with the purpose to reach a more precise solution, the majority of methods have been approached to the obtention of solutions in numerical form with the aim of take the advantages of modern computers, and for this reason a great deal of effort is dedicated to numerical solution of the equations of neutron transport. In agreement with the above mentioned, in this work has been developed a computer program which uses a relatively new technique known as 'acceleration of synthetic diffusion'

which has been applied to solve the neutron transport equation with 'classical schemes of spatial integration' obtaining results with a smaller quantity of interactions, if they compare to done without using such equation (Author).

7048 (RAL–92-044) **Data reduction and analysis programs for neutron reflection studies of monolayer adsorption at interfaces.** Penfold, J. National Radiological Protection Board, Chilton (United Kingdom). Jul 1992. [36] Order Number DE93610132. Source: OSTI; NTIS (US Sales Only); INIS.

Data reduction and analysis programs for neutron reflectivity data from monolayer adsorption at interfaces are described. The application of model fitting to the reflectivity data, and the determination of partial structure factors within the kinematic approximation are discussed. Recent data for the adsorption of surfactants at the air-solution interface are used to illustrate the programs described. (author).

7049 (RAL–92-045) **Comparison of kinematic and optical matrix methods for calculating reflectivity profiles of solid thin films and multilayers.** Eastoe, J.; Penfold, J. Rutherford Appleton Lab., Chilton (United Kingdom). Jul 1992. [24] Order Number DE93610133. Source: OSTI; NTIS (US Sales Only); INIS.

A comparison of the calculation of neutron reflectivity profiles R(Q) by optical matrix methods and a multilayer method, based on the kinematic approximation, has been made. The latter method provides a fast simple route to calculating R(Q) and may be used with confidence for systems of total thickness $\leq$200 "A" for a scattering length density difference "Delta" of the order of 1.0×10^{-5} A^{-2}. For thicker layers the approximation is poor and the optical matrix method must be used for an accurate evaluation of such reflectivity data over a wide Q range. (author).

7050 (UM-P–91/98) **A scalar Aharonov-Bohm experiment with neutrons.** Allman, B.E. (Melbourne Univ., Parkville (Australia). School of Physics); Cimmino, A.; Opat, G.I.; Kaiser, H.; Werner, S.A. Melbourne Univ., Parkville, VIC (Australia). School of Physics. [1992]. [13] Sponsored by Australian Research Council, Canberra, ACT (Australia). Grant NSF-PHY-9024608. Order Number DE93610134. Source: OSTI; NTIS (US Sales Only); INIS.

The scalar version of the Aharonov-Bohm effect predicts a phase shift for de Broglie waves due to the action of a scalar potential in an otherwise field-free (i.e. force-free) region of space. Unlike the more familiar effect due to the magnetic vector potential, the scalar effect has hitherto remained unverified due, presumably, to technical difficulties in electron interferometry. Rather than using electrons acted on by electrostatic potentials, an analogous interferometry experiment was performed with thermal neutrons subject to pulsed magnetic fields. The observations were carried out at the Missouri University Research Reactor, using a skew-symmetric perfect silicon crystal neutron interferometer. The expected phase shifts have been observed to a high degree of accuracy. 7 refs., 4 figs.

7051 (WSRC-TR–91-503) **Verification, validation, and benchmarking report for GILDA: An infinite lattice diffusion theory calculation.** Le, T.T. Westinghouse Savannah River Co., Aiken, SC (United States). Sep 1991. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE93004295. Source: OSTI; NTIS; GPO Dep.

This report concerns the verification and validation of GILDA, a static two dimensional infinite lattice diffusion theory code. The verification was performed to determine if GILDA was applying the correct theory and that all the subroutines function as required. The validation was performed to determine the accuracy of the code by comparing the results of the code with the integral transport solutions (GLASS) of benchmark problems. Since GLASS uses multigroup integral transport theory, a more accurate method than fewgroup diffusion theory, using solutions from GLASS as reference solutions to benchmark GILDA is acceptable. Eight benchmark problems used in this process are infinite mixed lattice problems. The lattice is constructed by repeating an infinite number of identical super-cells (zones). Two types of super-cell have been used for these benchmark problems: one consists of six Mark22 assemblies surrounding one control assembly and the other consists of three Mark16 fuel assemblies and three Mark31 target assemblies surrounding a control assembly.

6640 Atomic and Molecular Physics

Refer also to citation(s) 6991

6641 Theory of Electronic Structure of Atoms and Molecules

Refer also to citation(s) 6126

7052 (CONF-921116–3) **Classical and quantum dynamics of the impulsively driven hydrogen atom.** Melles, M. (Tennessee Univ., Knoxville, TN (United States)); Reinhold, C.O.; Burgdoerfer, J. Oak Ridge National Lab., TN (United States). [1992]. 13p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract AC05-84OR21400. From 12. international conference on the application of accelerators in research and industry; Denton, TX (United States); 2-5 Nov 1992. Order Number DE93002430. Source: OSTI; NTIS; INIS; GPO Dep.

We investigate the classical and quantum dynamics of the hydrogen atom in a Rydberg state subject to a sequence of periodic and random pulses. One goal of this study is to test the validity of classical electron transport theories. We analyze the critical momentum transfer for which 10% of the Rydberg atoms are ionized after a large number of pulses as a function of the frequency of the perturbation. The quantum mechanical results for a periodic sequence of pulses exhibit clear structures which are not present in a classical simulation. These structures are shown to vanish for the case of stochastic pulses for which agreement is obtained between the classical and quantum mechanical results. The dynamics of the quantum mechanical periodic system is analyzed in terms of quasi-eigenstates of the period-one time evolution operator.

7053 (IS-M–721) **Stable clusters in the condensed state and some possibilities for gas phase clusters.** Corbett, J.D.; Sevov, S.C. Ames Lab., IA (United States). 17 Sep 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-82. (CONF-920921–7: 6. international symposium on small particles and inorganic clusters, Chicago, IL (United States), 16-22 Sep 1992). Order Number DE93004446. Source: OSTI; NTIS; GPO Dep.

The classical naked cluster ions of the post-transition elements that are stable in solid compounds and their lower charged analogues observed in mixed metal beams reflect the reduced number of good bonding orbitals. New cluster ions of indium that are hypoelectronic (fewer than 2n + 2 skeletal bonding electrons) because of distortions or the bonding of heterometal atoms within the clusters are described. A large family of new, orbital-rich clusters of the group III and IV transition metals sheathed by halide are all centered by a wide variety of heteroatoms. Factors in their stability, possible analogous naked cluster targets, and some calculations are considered.

6642 Spectra of Atoms and Molecules and Their Interactions With Photons

Refer also to citation(s) 6111, 6193, 7064

7054 (ANL/PHY/CP–77423) **Spectroscopy of highly-ionized atoms using position-sensitive detection.** Kukla, K.W. (Notre Dame Univ., IN (United States). Dept. of Physics); Livingston, A.E.; Serpa, F.G.; Zacarias, A.S.; Berry, H.G.; Dunford, R.W.; Kanter, E.; Cheng, S.; Suleiman, J.; Curtis, L.J.; Traebert, E. Argonne National Lab., IL (United States). Physics Div. [1992]. 3p. Sponsored by USDOE, Washington, DC (United States); Deutsche Forschungsgemeinschaft, Bonn (Germany). DOE Contract W-31109-ENG-38 ;FG02-92ER14283 ;FG05-88ER13958. (CONF-920948–6: 6. international conference on physics of highly charged ions, Manhattan, KS (United States), 28 Sep - 2 oct 1992). Order Number DE93002914. Source: OSTI; NTIS; GPO Dep.

New results of atomic structure and atomic lifetime measurements in highly-ionized few-electron atoms obtained using position-sensitive detection of extreme ultraviolet emission from excited fast ions are reported. Data are presented from experiments

run at the Notre Dame Tandem Accelerator and at the Argonne ATLAS facility using beam foil spectroscopy with a photon-counting position-sensitive imaging detector. The results include excited state lifetimes in Si XI and Si XII involving both resonance transitions and Rydberg transitions, spectra of highly-ionized He-like, Li-like, and Be-like nickel including comparisons of electron capture and excitation processes for charge selected beams, and spectra and lifetimes in highly-charged bromine ions for both allowed and forbidden transitions. 4 figs, 3 refs.

7055 (BONN-IR-90-27) **VUV spectroscopy of ytterbium using laser and synchrotron radiation.** Kaenders, W.G. Bonn Univ. (Germany). Physikalisches Inst.; Bonn Univ. (Germany). Mathematisch-Naturwissenschaftliche Fakultaet. Jul 1990. 98p. (In German). Order Number DE93742758. Source: OSTI; NTIS (US Sales Only); INIS.

High resolution VUV spectroscopy ($\lambda/\Delta\lambda \simeq 10^5$) of Ytterbium I is performed using synchrotron radiation in combination with a 3m spectrograph and a newly developed VUV laser system in combination with a thermionic diode detector offering good linearity. The VUV laser is based on a resonantly enhanced sum-difference scheme in Krypton and provides the most intense tunable VUV light source (bandwidth 6 GHz) available at present. The principal and intercombination series (n=12 to 70) are studied and their relative intensities are given, revealing the strong influence of perturbers. The Zeeman effect in a field of 5.7 Tesla is exploited to extract g-factors. Numerous Rydberg series in the autoionising range (1330 - 1430 A) converging to the $^2F_{7/2}$, $^2D_{3/2}$ and $^2D_{5/2}$ limits are investigated. Multiple q-reversals can be observed. Lu-Fano-Plots and a K-Matrix approach are used to disentangle the strong interactions between the one-electron inner shell excitations of the closed $4f^{14}$ subshell and the doubly excited valence shell. (orig.).

7056 (DOE/ER/13958-30) **Semiempirical studies of atomic structure: Progress report, 1 March 1992--15 December 1992.** Curtis, L.J. Toledo Univ., OH (United States). Dept. of Physics and Astronomy. [1992]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-88ER13958. Order Number DE93005117. Source: OSTI; NTIS; INIS; GPO Dep.

The energy level structure, transition probabilities, and general spectroscopic properties of highly ionized many-electron systems are studied through the combined use of sensitive semiempirical data systematizations, selected precision experimental measurements, and specialized theoretical computations. Measurements are made primarily through the use of fast ion beam excitation methods, which are combined with available data from laser-and tokamak-produced plasmas, astrophysical sources, and conventional light sources. The experimental studies are strengthened through large-scale ab initio calculations. Typical examples are the following: lifetime measurements in the neon isoelectronic sequence; multiplexed decay curve measurements of Li-like Si XII; and isoelectronic specification of intershell resonance and intercombination decay rates using measured transition probabilities and spectroscopically determined singlet-mixing amplitudes.

7057 (ESM-38) **Electron momentum spectroscopy of atoms, molecules and solids.** Weigold, E. Flinders Univ. of South Australia, Adelaide (Australia). Electronic Structure of Materials Centre. Jan 1992. [16] Order Number DE93610148. Source: OSTI; NTIS (US Sales Only); INIS.

Electron Momentum Spectroscopy (EMS) is the application of the (e,2 e) technique to obtain detailed information on the dynamic structure of atoms, molecules, and condensed matter. The ability of EMS to provide wavefunction mapping, in terms of the independent particle representation of a many body system in momentum space, is discussed for valence electrons. The quantitative measurement of correlation effects in both the initial and final electron states is demonstrated. Correlations can significantly change the momentum density distribution, as well as giving rise to transitions forbidden in the independent particle approximation. The case of argon is discussed in some detail since both initial state correlations (d-wave correlations) and final state correlations (mainly in the 3 s^{-1} manifold) are present. The influence of relativistic effects in outer valence momentum densities is demonstrated for Xe and Pb. The importance of correlations in the outer valence orbitals of some molecules is discussed with particular reference to H_2O. The first (e,2 e) results on an excited target and also an oriented target are discussed, as are some recent high resolution measurements on amorphous carbon. 35 refs., 12 figs.

7058 (ESM-39) **Recent advances in electron momentum spectroscopy.** Weigold, E. Flinders Univ. of South Australia, Adelaide (Australia). Electronic Structure of Materials Centre. Mar 1992. [36] Sponsored by Australian Research Council, Canberra, ACT (Australia). Order Number DE93610149. Source: OSTI; NTIS (US Sales Only); INIS.

The flexibility of the (e,2 e) technique or electron momentum spectroscopy in obtaining information on the electronic structure of atoms, molecules, and solids is demonstrated. High resolution electron momentum spectroscopy measurements for argon including the first measurements of momentum profiles belonging to the $^2p^0$ and $^2D^e$ manifolds are used to demonstrate the technique for atomic targets. The d-wave transitions in argon are entirely due to initial state correlations. The first (e,2 e) measurements on an excited target and also on an oriented target are also discussed. Sodium atoms are pumped to the $m_l = +1$ state of the excited 3 p state by σ^+ light from a laser. The (e,2 e) measurements on this excited state are in excellent agreement with the momentum density given by the 3 p (m_l - 1) Hartree-Fock wavefunction. The recent measurements of the valence electron momentum distributions for ethane as well as some earlier results for water are used as an example of the application of EMS to the study of molecules. The application of the EMS technique to measure spectral momentum densities in condensed matter targets is demonstrated by some recent results on amorphous carbon. 19 figs., 1 tab., 38 refs.

7059 (UCRL-53943-91, pp. 9-10) **Nuclear spin polarization.** Souers, P.C. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990--1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

Magnetic-resonance studies of solid, normal, deuterium-tritium (DT) have shown that the nuclear relaxation times are too short for nuclear polarization. Removal of the first-excited (J = 1) rotational state of molecular hydrogen increases these times, but tritium radioactivity decreases them again. Hydrogen atoms have been found in densities adequate to support nuclear polarization. Synthesis of superpure molecular DT is the most likely future solution to the problem of creating a DT sample capable of sustaining polarization.

6643 Collision Phenomena

Refer also to citation(s) 6125, 6168, 7076

7060 (ANL/PHY/CP-77677) **Lifetime of the $2^2S_{1/2}$ state in hydrogenlike krypton.** Cheng, S. (Argonne National Lab., IL (United States). Physics Div.); Dunford, R.W.; Kanter, E.P.; Berry, H.G.; Gemmell, D.S.; Zabransky, B.J.; Livingston, A.E.; Curtis, L.J.; Bailey, J.; Nolen, J. Argonne National Lab., IL (United States). Physics Div. [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38 ;FG05-88ER13958. (CONF-920948--8: 6. international conference on physics of highly charged ions, Manhattan, KS (United States), 28 Sep - 2 oct 1992). Order Number DE93002912. Source: OSTI; NTIS; INIS; GPO Dep.

We report a measurement of the lifetime of $2^2S_{\frac{1}{2}}$ level in hydrogenlike ^{84}Kr and the first determination of the branching ratio for the M decay for this Z=36 one-electron ion. The lifetime of this state was measured by the beam-foil time-of-flight method, in which the foil was moved relative to a fixed, collimated Si(Li) detector. An analysis based on the single photon spectra from a tightly collimated detector led to the measurements of the lifetime of $2^2S_{\frac{1}{2}}$, the two-photon emission rate, the M emission rate and the branching ratio of M decay. All these experimental results are in good agreement with the theoretical calculations of Parpia and Johnson, and Goldman and Drake.

7061 (CONF-8909210--, pp. 255-266) **Non-perturbative behaviors in excitation and ionization of atoms by fast charged**

particles. Gayet, R. (Univ. Bordeaux I, Talence (France)); Salin, A. Oak Ridge National Lab., TN (United States). Apr 1990. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

Non-perturbative behaviors in collisions at rather high impact velocities are exhibited by means of special theoretical treatments. In the cases of excitation and ionization processes, it is shown that saturation effects may appear in contradiction with the predictions of the first Born approximation.

7062 (CONF-8909210–, pp. 573-593) **Cross sections for K-shell ionization by electron impact.** Mayol, R. (Univ. de Barcelona (Spain)); Salvat, F. Oak Ridge National Lab., TN (United States). Apr 1990. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

A semi-empirical method to compute the cross section for K-shell ionization of atoms by electron impact is proposed. The method involves a simple schematization of the Bethe surface, which is obtained from a hydrogenic optical oscillator strength density model. The use of these oscillator strengths determines the effective number of electrons that participate in ionizing distant collisions, i.e. the contribution of the considered shell to the Thomas-Reiche-Kuhn sum rule. Close collisions are described by the Moller differential cross section, thus incorporating exchange effects. Density effect corrections are not included in the present approach. The relationship of the approximation with the Weizsacker-Williams method of virtual quanta is also discussed.

7063 (CONF-9204186–1) **Towards a time-dependent description of electron-atom/ion collisions: Two electron systems.** Bottcher, C.; Madison, D.H.; Schultz, D.R. Oak Ridge National Lab., TN (United States). [1992]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Future direction in electron-ion collision physics; Atlanta, GA (United States); 9-10 Apr 1992. Order Number DE93004531. Source: OSTI; NTIS; INIS; GPO Dep.

This report contains the following discussions on a time-dependent description of electron-atom/ion collisions: numerical calculation of correlated wavefunctions for the coulomb three-body problem; the basis-spline collocation method; and time-dependent perturbation theory model.

7064 (CONF-921116–11) **Possible two-electron excitations in C^{3+} following 1 MeT/u collisions with atomic targets; Z = 2, 10, 18 and 36.** Deveney, E.F. (Connecticut Univ., Storrs, CT (United States)); Kessel, Q.C.; Fuller, R.J.; Reaves, M.P.; Shafroth, S.M.; Jones, N. Oak Ridge National Lab., TN (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract AC05-84OR21400. Grant PHY-8818347. From 12. international conference on the application of accelerators in research and industry; Denton, TX (United States); 2-5 Nov 1992. Order Number DE93003013. Source: OSTI; NTIS; GPO Dep.

Auger electrons emitted from Li-like Carbon projectiles excited during I MeV/u collisions with atomic targets (Z = 2, 10, 18 and 36) have been measured. As a function of the target Z, we observe the yieldsof singly and doubly excited autoionizing configurations (AI) of C^{3+} excited during the collision that decay to the $(1s^2(^1S) + e_c\ell_c)^2L$ ground state. The investigation focuses on Auger electrons emitted with energies between 220 and 260 eV in the projectile reference frame. In addition to the singly excited $(1s2s2\ell)^2L$ AI configurations expected from projectile 1s electron excitation, doubly excited states to the $(1s(2p^2)^1D)^2D$ and $(1s(2p^2)^1S)^2S$ are also observed with increasing intensities in going from He to the higher Z targets. If the ^2D and the ^2S peaks are the result of two-electron excitations, it may be possible to investigate this aspect of the collision using some of the recent approaches taken in studying the excitations of the two electrons in He targets.

7065 (DOE/ER/13549–7) **[Electron transfer, ionization, and excitation in atomic collisions]: Progress report.** Pennsylvania State Univ., University Park, PA (United States). [1992]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-86ER13549. Order Number DE93005918. Source: OSTI; NTIS; INIS; GPO Dep.

Fundamental processes of electron transfer, ionization, and excitation in ion-atom and ion-ion collisions are studied. Attention is focussed on one- and two-electron systems and, more recently, quasi-one-electron systems whose electron-target-ion core can be accurately modeled by one-electron potentials. The basic computational approaches can then be taken with few, if any, approximations, and the underlying collisional mechanisms can be more clearly revealed. At intermediate collision energies (e.g., proton energies for p-He^+ collisions on the order of 100 kilo-electron volts), many electronic states are strongly coupled during the collision, a coupled-state approach, such as a coupled-Sturmian-pseudostate approach, is appropriate. At higher collision energies (million electron-volt energies) the coupling is weaker with, however, many more states being coupled together, so that high-order perturbation theory is essential.

7066 (ESM–44) **Integrated cross sections for the ionisation of atomic hydrogen by electron impact.** Konovalov, D.A.; McCarthy, I.E. Flinders Univ. of South Australia, Adelaide (Australia). Electronic Structure of Materials Centre. May 1992. [10] Sponsored by Australian Research Council, Canberra, ACT (Australia). Order Number DE93610179. Source: OSTI; NTIS (US Sales Only); INIS.

Distorted-wave Born approximation (DWBA) calculations are reported for singly-differential and total cross sections for the electron impact ionisation for atomic hydrogen at 25, 40, 60, 100, 150 and 250 eV. The theory is compared with available experiments. At all the energies except 25 eV the theory predicts a lower singly-differential cross section for the low-energy side of the secondary-electron energies (<5 eV), compared to the only available absolute measurements of Shyn (1992). The DWBA calculation is in good agreement with the experiment at 25 eV but only if e-e post-collision interaction is included in the theory in some way. 23 refs., 2 figs.

7067 (ESM–47) **Calculation of the total ionization cross section and spin asymmetry in electron-hydrogen scattering from threshold to 500 eV.** Bray, I. (Flinders Univ. of South Australia, Adelaide (Australia). Electronic Structure of Materials Centre); Stelbovics, A.T. Flinders Univ. of South Australia, Adelaide (Australia). Electronic Structure of Materials Centre. Jul 1992. [9] Order Number DE93610180. Source: OSTI; NTIS (US Sales Only); INIS.

The total ionization cross section and spin asymmetry at projectile energies ranging from threshold to 500 eV for electron impact excitation of atomic hydrogen is presented. They are calculated using the convergent close-coupling formalism of Bray and Stelbovics. Both observables are found to be in complete quantitative agreement with measurements over almost the entire energy range. This is the only electron-atom scattering theory that is able to achieve this result to date. 20 refs., 2 figs.

7068 (ETDE/JP-mf–93753763, pp. 322-332) **Superconducting accelerator.: Present status of supertechnology.** Hirabayashi, H. (National Laboratory for Hihgh Energy Physics, Tsukuba (Japan)). Cryogenic Association of Japan, Tokyo (Japan). [1991]. 606p. (In Japanese). In *Proceedings of the 1st-4th cryogenic engineering summer seminar (1988-1991).* Order Number DE93753763. Source: OSTI; NTIS (US Sales Only).

The high energy accelerator was explained in motive for the development and principle together with its being made superconductive. Complying with an electromagnetic rule, the accelerator accelerates the charged nucleon flux. Though the upper limit of energy is presently in the order of 2×10^{12}eV, it is a scholastic motive to precisely prove the phenomenon up to the order of 10^{13}eV. The application of superconduction technology miniaturizes the accelerator to (1/2) to (1/5) by the steep slope of acceleration electric field and generation of strong magnetic field so that the required power can be reduced to (1/10) to (1/50). Therefore with a very large heightening in efficiency, the accelerator is expected to be improved in performance by 20 to 250 times. If made of high purity

Nb and Pb, the accelerating tube of frequency resonance accelerating cavity or linear type accelerator becomes a superconducting accelerator. On the inside surface of cavity, the high frequency loss is so small as to give a violent resonance and high frequency stability. The superconducting proton synchrotron is a circumferentially rotating acceleration type accelerator which utilizes the superconducting magnet. Such a superconducting magnet system being mainly bi-polar or tetro-polar, bi-polar one is used in the Superconducting Super Collider Project, USA. Also explained was the orbital radiation optical source of superconducting synchrotron. 5 refs., 6 figs., 2 tabs.

7069 (GSI–92-09) **Multiple electromagnetic pair production in ultrarelativistic heavy ion collisions.** Best, C. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany); Frankfurt Univ. (Germany). Inst. fuer Theoretische Physik. Apr 1992. 145p. (In German). Order Number DE93742920. Source: OSTI; NTIS (US Sales Only); INIS.

The problem of the unitary violation in the pair production in ultrarelativistic heavy ion collisions was studied by a consideration of the field-theoretical foundations. The quantum electrodynamics in an external field were thereby reduced to a Dirac-sea model, the equivalence of which to the non-radiative QED resulted from the equality of the generating functionals. The latter can both be expressed explicitely by means of the complet set of the solutions of the Dirac equation in an external field. This method is based solely on the path-integral approach, which makes it possible to discriminate clearly between the physically given correlation functions and their generating functional at the one hand and at the other hand between the models constructed to their interpretation. From the model expression for the pair production amplitudes and multiplicities could be calculated, for which only the knowledge of the one-particle S matrix is necessary. For the calculation of the multiplicities different forms of the perturbation theory were discussed. Finally an impact-parameter dependent Weizsaecker-Williams approximation for the calculation of arbitrary two-photon graphs was constructed and applied to the given problem. The results indicate that at small distances very high pair multiplicities are to be expected. Finally a new approach to the pair production in an external field was discussed, which is not based on the canonical field theory, but on the formalism of the Wigner functions. (orig./HSI).

7070 (PNL-SA–21302) **Differential electron emission in multi-charged ion atom collisions: Systematics for distant and close collisions.** DuBois, R.D. (Pacific Northwest Lab., Richland, WA (United States)); Toburen, L.H.; Middendorf, M.E.; Jagutzki, O. Pacific Northwest Lab., Richland, WA (United States). Sep 1992. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-920948–11: 6. international conference on physics of highly charged ions, Manhattan, KS (United States), 28 Sep - 2 oct 1992). Order Number DE93004324. Source: OSTI; NTIS; INIS; GPO Dep.

Absolute doubly differential cross sections for electron emission are presented for 0.5 MeV/u multi-charged ion impact on helium, neon, and argon targets. For the helium target, Bq+, Cq+ (q = 2–5) and Oq+, Fq+ (q = 3–6) projectiles were studied; for neon and argon, only Cq+ (q = 2–5) projectiles were used. Electron emission for $10° \leq \Theta \leq 60°$ was studied. The measured cross sections were assumed to scale as the square of an effective projectile charge, Z_{eff}, which was determined as a function of emitted electron energy and angle. For distant collisions (low emitted electron energies), we find that $Z_{eff} \approx q$ for small q and $Z_{eff} < q$ for the highest values of q investigated. For sufficiently close collisions (above the binary encounter peak), $Z_{eff} > Z$ and increases as q decreases. This is true for all angles and targets investigated.

7071 (UCRL-JC–111467) **Electron impact excitation cross section measurements of highly charged heliumlike and lithiumlike ions.** Wong, K.L.; Beiersdorfer, P.; Marrs, R.E.; Reed, K.J.; Vogel, D.A. Lawrence Livermore National Lab., CA (United States). 15 Sep 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-920948–9: 6. international conference on physics of highly charged ions, Manhattan, KS (United States), 28 Sep - 2 oct 1992). Order Number DE93003478. Source: OSTI; NTIS; INIS; GPO Dep.

The cross sections for electron impact excitation of the heliumlike forbidden line z, intercombination lines y and x, and the resonance line w, together with the associated lithiumlike satellites lines q, r, t, u, and v have been measured for Ti, V, Cr, Mn, and Fe on the Livermore electron beam ion trap. The measurements were made near the threshold for excitation of the heliumlike transitions where no other processes can contribute to the excitation of the lines. The uncertainties in the measurements are up to 15% for the heliumlike transitions and between 14 and 27% for the lithiumlike transitions. We find good agreement with results from a distorted-wave calculation.

7072 (UM-P–92/12) **On semiclassical inversion of heavy ion scattering phase shifts.** Allen, L.J. (Melbourne Univ., Parkville (Australia). School of Physics); Amos, K.; Fiedeldey, H. Melbourne Univ., Parkville, VIC (Australia). School of Physics. [1992]. [10] Sponsored by Australian Research Council, Canberra, ACT (Australia). Order Number DE93610181. Source: OSTI; NTIS (US Sales Only); INIS.

It is demonstrated that semiclassical inversion which was successfully applied to heavy-ion scattering data at relatively high energies also works well at lower energies from 35 MeV/nucleon down to 10 MeV/nucleon. This is demonstrated for elastic scattering of ^{12}C from ^{90}Zr at 420 MeV and from ^{208}Pb at 420 and 125 MeV. As a further low energy example, semiclassical inversion of the elastic scattering at 170 MeV of ^{16}O from ^{208}Pb is also reported. 7 refs., 2 figs.

6644 Experimentally Derived Information On Atomic and Molecular Properties

Refer also to citation(s) 7054, 7071

7073 (ANL/PHY/CP–77109) **Overview of helium-like structure measurements: A focus on the N = 2 triplet states.** Berry, H.G.; Dunford, R.W. Argonne National Lab., IL (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-920948–7: 6. international conference on physics of highly charged ions, Manhattan, KS (United States), 28 Sep - 2 oct 1992). Order Number DE93002913. Source: OSTI; NTIS; INIS; GPO Dep.

We present a comprehensive analysis of existing measurements of the $1s2s\ ^3S_1 - 1s2p^3P_{0,1,2}$ transition energies in heliumlike ions for nuclear charges Z=2 to Z=92. We find agreement with the standard unified calculations of |Drake except for the transitions from the $1s2p\ ^3P_o$ state. We find a deviation equal to $2.3x(Z/10)^4\ cm^{-1}$ for the most precise existing measurements.

7074 (SAND–92-8629C) **Stark quantum-beat spectroscopy: The electric dipole moment of NO ($A\ ^2\Sigma^+$).** Gray, J.A.; Farrow, R.L.; Durant, J.L. Jr.; Thorne, L.R. Sandia National Labs., Livermore, CA (United States). [1993]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930151–1: 1. Optical Society of America (OSA) meeting on high resolution spectroscopy, Salt Lake City, UT (United States), 18-21 Jan 1993). Order Number DE93002672. Source: OSTI; NTIS; INIS; GPO Dep.

We observe fluorescence quantum beats in fields $\leq$ 22.5 kV/cm. Fourior analysis yields narrow (2 MHz) Stark/hyperfine frequencies which are fit to a model Hamiltonian.

7075 (SAND–93-8401C) **Perturbative nearly-degenerate four-wave mixing lineshapes in gases.** Rahn, L.A. Sandia National Labs., Livermore, CA (United States). [1992]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-930151–2: 1. Optical Society of America (OSA) meeting on high resolution spectroscopy, Salt Lake City, UT (United States), 18-21 Jan 1993). Order Number DE93002673. Source: OSTI; NTIS; INIS; GPO Dep.

Nearly-degenerate four-wave mixing (NDFWM) spectroscopy and the closely related tunable-laser-induced grating spectroscopies have proved to be valuable tools in the study of nonlinear optical interactions. The NDFWM spectral lineshape provides information concerning the lifetimes, and therefore the identities, of multiphoton

scattering mechanisms. In addition to the great number of investigations in liquids and solids, considerable research has focused on wave-mixing in resonant atomic gases for phase conjugation applications. Although many special cases have been discussed, general expressions that include the effects of molecular motion for the NDFWM lineshape in gases have not been previously reported. The present study is motivated by an interest in understanding the mechanisms contributing to degenerate four-wave mixing (DFWM) spectroscopy in molecular gases for application to combustion and chemical physics research. In this study, expressions for the NDFWM lineshape have been developed for nearly forward- and counter-propagating collinear pump-beam geometries. The lineshapes have been derived by applying the velocity integration methods used by Lam and Abrams for the phase-conjugate DFWM to the perturbation-theory expressions developed by Tretout, et al. for resonance coherent anti-Stokes Raman spectroscopy. The resultant expressions thus include the effects of molecular degeneracy on the polarization characteristics of X.

7076 (UCRL-LR–111710) **Electron impact ionization of highly charged lithiumlike ions.** Vogel, D.A. Lawrence Livermore National Lab., CA (United States). Aug 1992. 290p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93002895. Source: OSTI; NTIS; GPO Dep.

The goal of this thesis is to observe inner-shell ionization of highly-charged lithiumlike ions by electron collision, and to determine the cross section for ionization at different energies. Two elements,chromium and iron, were selected for the investigation. The two elements are close together in the periodic table, with atomic numbers of Z = 24 and Z = 26 respectively. In the lithiumlike state, all of their electrons except the last three have been removed, leaving a highly-charged positive ion with the atomic configuration $1s^2\ 2s\ D^2S_{1/2}$. Removal of an inner-shell electron, that is, a 1s electron,from these highly-charged ions requires a relatively large energy transfer from the colliding electron, 7350 eV for Cr^{21+} and 8685 eV for Fe^{23+}.The process leaves the ion in an excited heliumlike configuration, ls2s, and the excited ions can decay radiatively to the heliumlike ground state, producing observable x rays. It is these decay x rays that provide the means of detecting the ionization events and measuring the impact ionization cross section.

6650 Physics of Condensed Matter

Refer also to citation(s) 5275, 5909, 5913, 5930, 5973, 5974, 6060, 6083, 6231, 6858, 7488

7077 (CBPF-NF–033/91) **Magnetization reversal by nucleation.** Baltensperger, W. (Eidgenoessische Technische Hochschule, Zurich (Switzerland). Inst. fuer Theoretische Physik); Broz, J.S.; Helman, J.A.S. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1991. [9] Order Number DE93610313. Source: OSTI; NTIS (US Sales Only); INIS.

The exact static solution of the Landau-Lifshitz equations for the magnetization, which have been identified as describing nucleation centers for the magnetization reversal in ferromagnets, are compared with those of phenomenological models of spherical and cylindrical symmetry. It is found that the latter have higher critical fields. (author).

7078 (CBPF-NF–034/91) **Effect of a distribution of exchange parameters within a simple localized-itinerant model.** Iannarella, L.; Guimaraes, A.P.; Silva, X.A. da. Centro Brasileiro de Pesquisas Fisicas (CBPF), Rio de Janeiro, RJ (Brazil). 1991. [16] Order Number DE93610314. Source: OSTI; NTIS (US Sales Only); INIS.

The magnetic behaviour at T = 0 K of a system consisting of conduction electrons coupled to localized electrons submitted to an axial crystal field is studied in the molecular field approximation. We assume that the exchange parameter J varies spatially, with a Gaussian probability distribution. We define an average ionic magnetic moment and obtain the condition for spontaneous magnetic order, involving the crystal field parameter, the width and the mean value of the exchange parameter distribution. We also obtain graphs of the magnetic moment versus mean value of the exchange parameter distribution, for different distributions showing that the distribution of J's reduces the rate of increase of magnetization versus the mean J. (author).

7079 (CONF-8909210–, pp. 303-311) **Non-local exchange-correlation potential at a metal surface from many-body perturbation theory.** Eguiluz, A.G. (Montana State Univ., Bozeman (United States)). Oak Ridge National Lab., TN (United States). Apr 1990. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

The author reports a first-principles evaluation of the exchange-correlation potential (V_{xc}) at a metal surface. An integral equation relating (V_{xc}) and the non-local electron self-energy (Σ_{xc}) is solved numerically for a free-electron metal surface, with use of a static approximation for Σ_{xc}. The strongly-inhomogeneous nature of the electron density profile at the surface is treated exactly, i.e., without invoking the usual local density approximation. The result for V_{xc} has the correct image-like asymptotic behavior; it derives implicitly from a non-local exchange-correlation energy functional. He studies the effect of non-locality on the position of the effective image plane (z_0) from an analysis of the image tail of V_{xc} and also from linear-response theory. The difference in the values of z_0 obtained by both method for low metallic densities is attributed to electron overlap effects. He also discusses the effects of V_{xc} on image-potential induced surface states.

7080 (CONF-900971–5) **Thermodynamic properties of fluids from Fluctuation Solution Theory.** O'Connell, J.P. Virginia Univ., Charlottesville, VA (United States). Dept. of Chemical Engineering. [1990]. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-88ER13943. From 12. European conference on thermophysical properties: ECTP-12; Vienna (Austria); 24-28 Sep 1990. Order Number DE93003072. Source: OSTI; NTiS; INIS; GPO Dep.

Fluctuation Theory develops exact relations between integrals of molecular correlation functions and concentration derivatives of pressure and chemical potential. These quantities can be usefully correlated, particularly for mechanical and thermal properties of pure and mixed dense fluids and for activities of strongly nonideal liquid solutions. The expressions yield unique formulae for the desirable thermodynamic properties of activity and density. The molecular theory origins of the flucuation properties, their behavior for systems of technical interest and some of their successful correlations will be described. Suggestions for fruitful directions will be suggested.

7081 (DOE/ER/45324–T2) **[Experimental studies of critical behavior of systems with quenched disorder]: Progress report, 1987–1993.** Belanger, D.P. California Univ., Santa Cruz, CA (United States). Dept. of Physics. 1 Jul 1992. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-87ER45324. Order Number DE93005090. Source: OSTI; NTIS; INIS; GPO Dep.

this document details progress made in the areas of: specific heat of random-field Ising antiferromagnets; the dilute Ising antiferromagnet near the percolation threshold; spin-echo neutron scattering; optical birefringence in $SrTiO_3$; neutron scattering in epitaxial thin films; specific heat measurements in stacked triangular antiferromagnets; and the decay of the remnant magnetization in field-cooled antiferromagnets.

7082 (LBL–32832) **Towards a first-principles thermodynamics of solids.** de Fontaine, D.; Wolverton, C. Lawrence Berkeley Lab., CA (United States). Aug 1992. 31p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-9205273–1: 91. annual conference of the Deutsche Bunsen-Gesellschaft fuer Physikalische Chemie, Vienna (Austria), 28-30 May 1992). Order Number DE93002544. Source: OSTI; NTIS; GPO Dep.

Total energy density-functional methods have made it possible to calculate, from first principles, such important properties as cohesive energies, lattice constants and elastic moduli for elemental

crystals and perfectly ordered compounds. Real solids are imperfect, however, so that lattice vibrations and compositional disorder lead to entropy contributions, vibrational and configurational. When these effects are included in an appropriate manner, properties of real crystals can be computed ab initio as a function of temperature and concentration. Consequently, it is possible to obtain, virtually from the knowledge of atomic numbers alone, such basic thermodynamic properties as free energies, entropies, heats of formation, and lattice parameters for stable and metastable phases, leading, for example, to the successful computation of certain classes of phase diagrams. Recent progress in the field will be reviewed. Application is made to the Pd-Rh-V system.

7083 (SAND–91-2174C) **Direct second kind boundary integral formulation for Stokes flow problems.** Mondy, L.A. (Sandia National Labs., Albuquerque, NM (United States)); Ingber, M.S. Sandia National Labs., Albuquerque, NM (United States). [1991]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-920852–5: 11. international congress of rheology, Brussels (Belgium), 17-21 Aug 1992). Order Number DE93004069. Source: OSTI; NTIS; GPO Dep.

In this paper we describe a DBEM for the Stokes problem which results in a fedholm integral equation of the second kind. This is accomplished by deriving a boundary integral equation for the components of traction (TBIE). We examine the applicability and compare the accuracy of boundary element methods based on the VBIE and the TBIE for two example problems. These examples demonstrate the efficacy of the method of regularization of the gypersingular integrals and the method of constraining out the rigid body eigenmodes for the TBIE. This work also demonstrates the robust nature of the VBIE for these problems that require a moderate number of boundary elements.

7084 (UCRL–53943-91, pp. 53-56) **Harmonic analysis of phonon echoes in liquids.** Bauer, J.D.; Calef, D.F. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science, 1990–1991. [Second annual report].* 241p. Order Number DE93001761. Source: OSTI; NTIS.

The authors have compared phonon quench echoes in supercooled liquid argon with a normal mode analysis of the echoes. The phonon echoes are produced by molecular dynamics simulation. They model the echoes by considering a collection of harmonic oscillators whose frequency distribution is defined by the density of normal modes in the liquid under consideration. For times less than 300 fs, they find that the fluid behaves in a relatively harmonic manner. It is also found that low temperatures and short times are best suited to harmonic analysis.

6651 Nuclear Techniques in Condensed Matter Physics

Refer also to citation(s) 5925, 5927, 5965, 6002, 6008, 6123, 6130, 6131, 6273, 7101, 7119

7085 (BNL–47750) **Surface science research at National Synchrotron Light Source.** Brookhaven National Lab., Upton, NY (United States). Jul 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE93002950. Source: OSTI; NTIS; GPO Dep.

This report discusses the measuring techniques used at the National Synchrotron Light Source for surfaces studies.

7086 (CONF-8909210–, pp. 289-302) **Direct methods in structure determination by LEED.** Pendry, J.B. (Imperial Coll., London (United Kingdom)). Oak Ridge National Lab., TN (United States). Apr 1990. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

Most techniques for determination of surface structure interpret the raw experimental data by trial and error methods. For complex structures this is a very time consuming process because of the exponential growth of possible structures with degrees of freedom. Direct Methods sidestep this difficulty. They have been studied in the context of x-ray diffraction and it is the heavy atom technique of x-ray crystallography that inspires their approach to the surface problem. The idea is that the bulk structure lying behind the surface is known, and a reference surface as near to the true surface structure as possible can be defined. It is subsequently treated as the heavy atom of the surface problem and all phases referred to the reference surface phases. The method works well for some simple examples and future applications of greater sophistication are discussed.

7087 (CONF-8909210–, pp. 343-350) **Inelastic positronium formation at metal surfaces.** Iitaka, Toshiaki (Waseda Univ., Tokyo (Japan)). Oak Ridge National Lab., TN (United States). Apr 1990. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

Positrons implanted into solids are thermalized in the solids, and diffused to the surface. Some of them are emitted from the surface as energetic positroniums changing the binding energy into kinetic energy. Positronium formation processes can be classified into two types, the direct- and inelastic-formation which correspond to resonant- and Auger-neutralization of ions, respectively, though many authors have studied the theory of the direct formation process only. The author studies, in this paper, inelastic formation by using surface dielectric function method, which has been widely used to get a simple formalism of low energy electron inelastic scattering, stopping power and energy straggling of ions near a metal surface, electron-hole pair excitation in atom-surface scattering and x-ray photoemission spectrum.

7088 (CONF-8909210–, pp. 421-434) **Effective mass of bulk and surface positrons due to plasmon excitation.** Shindo, Shigeru (Tokyo Gakugei Univ. (Japan)). Oak Ridge National Lab., TN (United States). Apr 1990. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

It has recently been known that a low energy positron beam provides a useful probe for studying solid surfaces, such as the LEPD (Low Energy Positron Diffraction), PELS (Positron Energy Loss spectroscopy), PsFS (Positronium formation Spectroscopy), and so on. For the experimental analysis, the investigation of the coupling of the positron with elementary excitations of solids (inelastic scattering) is very important. A recent experiment suggests that the inelastic scattering cross section of positrons in solids is much enhanced in comparison with the electron beam. The author has given an explanation for these experimental facts by taking account of the higher order perturbation terms. He calculates the effective mass of bulk and surface positrons. He shows that the mass of bulk positrons is enhanced due to plasmon excitations. He also calculates the effective mass of surface positrons due to surface plasmon excitations.

7089 (CONF-8909210–, pp. 537-550) **Radiation mechanisms for microscopic relativistic electron beams.** Moran, M.J. (Lawrence Livermore National Lab., CA (United States)). Oak Ridge National Lab., TN (United States). Apr 1990. DOE Contract W-7405-ENG-48. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

Relativistic electron beams are used to generate intense beams of coherent photons from the microwave to the x-ray spectral regions. The brightest sources of visible and x-ray radiation currently are based on synchrotron radiation from multi-GeV storage-ring electron beams. Continuing progress with techniques for generating microscopic-diameter ($d < 1{,}000$ Å) relativistic ($E > 1$ MeV) electron beams is making feasible new kinds of photon sources. These sources are based on diffraction radiation and they will have high radiation efficiencies for visible photon energies. With further improvements in electron beam quality, these sources might eventually be extended into the x-ray spectral region.

7090 (CONF-8909210–, pp. 651-672) **Collective aspects of charged particle track structure.** Basbas, G. (Physical Review Letters, Ridge, NY (United States)); Howie, A.; Ritchie, R.H. Oak Ridge National Lab., TN (United States). Apr 1990. DOE Contract AC05-84OR21400. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

A plasmon generated by a swift charged particle constitutes a coherent excitation about the particle track. The authors discuss the representation of collective modes in impact parameter space when created by a swift ion or a fast electron, and the decay of these modes into localized excitations. Several alternative spatial representations are considered. They show that the high spatial resolution found in secondary electron emission measurements with scanning electron microscopy is consistent with the existence of the plasmon as an intermediary between the fast incident electron and the measured secondary electrons.

7091 (EGG–10617-3017) **A review of the associated particle imaging technique.** Hurley, J.P.; Beyerle, A.; Durkee, R.; Headley, G.; Tunnell, L. EG and G Energy Measurements, Inc., Santa Barbara, CA (United States). Special Technologies Lab. [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-88NV10617. (CONF-921116–6: 12. international conference on the application of accelerators in research and industry, Denton, TX (United States), 2-5 Nov 1992). Order Number DE93002238. Source: OSTI; NTIS; INIS; GPO Dep.

Associated particle imaging (API) is a fast-neutron reaction imaging system. An object is illuminated with 14-MeV neutrons and these neutron interaction sites are imaged. The $T(d,n)^4He$ reaction is used to produce a neutron and an alpha particle which move apart in opposite directions. By detecting the alpha particle, the direction of travel of the neutron is known. When the neutron strikes any material (except hydrogen and helium) it causes the material to emit gamma radiation. If one of the gamma-rays is detected it is then known that a reaction has taken place. By measuring the time between alpha detection and gammadetection, it is known how long the neutron traveled before reacting. By constructing a tally (or histogram) of these reaction sites an image is constructed. By examining the gamma-ray spectra corresponding to each region of space, elemental analysis of that region can be performed. This technique and it's applications are discussed in this paper.

7092 (INIS-BR–3065) **Study of structural phase transition in $KD_3(Se\ O_3)_2$ and $Na\ H_3(Se\ O_3)_2$ by EPR.** Silva, J.C.M. da. Minas Gerais Univ., Belo Horizonte, MG (Brazil). 1988[113] (In Portuguese). Order Number DE93610321. Source: OSTI; NTIS (US Sales Only); INIS.

The electron paramagnetic resonance of $Se\ O^-_2$ centers in $KD_3(Se\ O_3)_2$ and $Na\ H_3(Se\ O_3)_2$ was done in the temperature ranges of -170^0 C o $+80^0$ C and $+25^0$ C to -185^0 C, respectively. (A.C.A.S.).

7093 (LA-UR–92-3236) **ESR spectra of photoinduced defects in MX chain solids.** Saxena, A. (Los Alamos National Lab., NM (United States)); Bishop, A.R.; Batistic, I.; Alouani, M. Los Alamos National Lab., NM (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9208132–6: 1992 international conference on science and technology of synthetic metals (ICSM), Goeteborg (Sweden), 12-18 Aug 1992). Order Number DE93003692. Source: OSTI; NTIS; INIS; GPO Dep.

We calculate the electron spin resonance (ESR) spectra associated with the spin carrying nonlinear excitations such as neutral solitons, triplet excitons as well as electron and hole polarons for halogen-bridged mixed-valence transition metal (MX: M=Pt, X=Cl,Br,I) linear chain materials within a discrete, 3/4-filled, two-band, tight-binding extended Peierls-Hubbard model. The strongly distorted and localized CDW material, PtCl, is contrasted with the weak CDW, delocalized material, PtBr. The hyperfine structure in the ESR spectra arises from the spin density on the Pt atoms while the superhyperfine structure is attributed to a small spin density present on the halogen sublattice. These theoretical predictions are compared with the recent experimental ESR data on photoinduced defects in PtX materials.

7094 (LA-UR–92-3271) **Solutions for implementing time-of-flight techniques in low-angle neutron scattering, as realized on the Low-Q Diffractometer at Los Alamos.** Hjelm, R.P. Jr.; Seeger, P.A. Los Alamos National Lab., NM (United States). [1992]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9209225–2: International seminar on structural investigation at pulsed neutron sources, Dubna (Russian Federation), 1-4 Sep 1992). Order Number DE93003702. Source: OSTI; NTIS; INIS; GPO Dep.

The implementation of small-angle (Low-momentum transfer) neutron scattering at pulsed spallation sources, using time of flight methods, has meant the introduction of some new ideas in instrument design, data acquisition, data reduction and computer management of the experiment and the data. Here we recount some of the salient aspects of solutions for implementing time of fight small-angle neutron scattering instruments at pulsed sources, as realized on the Low-Q Diffractometer, LQD, at Los Alamos. We consider, fortlier, some of the problems that are yet to be solved, and take a short excursion into the future of SANS instrumentation at pulsed sources.

7095 (SAND–92-1594C) **Heavy Ion Backscattering Spectrometry for high sensitivity.** Knapp, J.A. Sandia National Labs., Albuquerque, NM (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-921116–8: 12. international conference on the application of accelerators in research and industry, Denton, TX (United States), 2-5 Nov 1992). Order Number DE93002489. Source: OSTI; NTIS; INIS; GPO Dep.

Heavy Ion Backscattering Spectrometry (HIBS) using moderate energy (a few hundred keV) heavy ions has demonstrated sensitivity for medium-to-heavy surface impurities on Si more than 1000x greater than conventional Rutherford Backscattering Spectrometry (RBS). Problems with pileup are eliminated by a thin, self-supporting foil in front of the surface barrier detector (SBD), ranging out ions scattered from the substrate and allowing only ions scattered from impurities heavier than the substrate to reach the detector. Limitations to a SBD approach arise from relatively poor resolution at low energies, leading to the inability to resolve closely spaced impurity masses (such as Fe and Cu), as well as necessitating an analysis beam of 200 key or higher. In order to bypass these limitations and explore means of increasing sensitivity and mass resolution, we have built a Time-of-Flight (TOF) HIBS prototype, optimized for large solid angle.

7096 (UM-P–92/15) **HRTEM in protein crystallography.** Dyson, P.W. (Melbourne Univ., Parkville (Australia). School of Physics); Spargo, A.E.C.; Tulloch, P.A.; Johnson, A.W.S. Melbourne Univ., Parkville, VIC (Australia). School of Physics. [1992]. [2] Order Number DE93610322. Source: OSTI; NTIS (US Sales Only); INIS.

Electron microscopy/diffraction (ED/D) using spot-scan and low-dose imaging has been successfully applied to investigate microcrystals of an alpha-helical coiled-coil protein extracted from ootheca of the praying mantis. Fourier transforms of the images show resolution out to 4 Angstroems and can be used to phase the corresponding ED data which shows reflections out to 2 Aangstroems. 5 refs., 3 figs.

6653 Interactions Between Beams and Condensed Matter

Refer also to citation(s) 5225, 5926, 6039, 6040, 6042, 6166, 6320, 6832, 7035, 7036, 7037, 7038, 7039, 7040, 7041, 7042, 7087, 7088, 7090, 7257

7097 (CONF-8909210–, pp. 15-23) **Influence of the wake potential on inelastic scattering using a small probe in confined volumes.** Batson, P.E. (IBM Thomas J. Watson Research Center, Yorktown Heights, NY (United States)); Bruley, J. Oak Ridge National Lab., TN (United States). Apr 1990. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The*

12th Werner Brandt international conference on the penetration of charged particles in matter. 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

When a fast electron penetrates a solid at a velocity, v, greater than the Fermi velocity, v_F, a charge density wake is created. The wake results from the hydrodynamic response of the system to the coulomb potential of the fast electron. The authors reproduce results from Ritchie and Echenique for the potential and differential charge density which corresponds to the wake. The potential highly anisotropic, having a wavelength of $2\pi v/\omega_p$ behind the fast electron and parallel to its trajectory, and a wavelength of h/mv ahead and to the side of the trajectory. In effect, the wake is a real space representation of the plasmon and quasi-particle continuum. For instance, at a certain distance behind the fast electron, the potential is mainly plasmon-like. Moving to the side, this plasmon potential becomes shorter in wavelength. When the wake position is reached at the wake angle $\Theta = \sin^{-1} v_f/v$, the plasmon potential has a wavelength similar to single quasi-particles, and the plasmon merges with the single particle continuum to the side of and in front of the fast electron. Scaling from results for fast ions, the authors expect that the depth of the wake potential will be of order $e\omega_p/v \sim$ 0.25 eV for Silicon at 100KeV incident electron energy, increasing to 0.5 eV for diamond. The integrated response charge which is responsible for this potential equals the fast electron charge within 10-20nm behind the incident electron. Therefore, 5-10nm behind the fast electron, the total potential will be highly distorted by the wake. On the other hand, the wake potential is confined within 1-2nm in the lateral direction. Thus, if inelastic scattering occurs with an impact parameter smaller than 1-2nm, one might expect the wake potential to influence the amount and type of the scattering.

7098 (CONF-8909210–, pp. 61-68) **Dispersion effects and spatial resolution in STEM.** Zabala, N. (Euskal Herriko Unibertsitatea, Bilbao (Spain)); Echenique, P.M. Oak Ridge National Lab., TN (United States). Apr 1990. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

The excitation probability of a STEM electron moving parallel to a vacuum-metal interface is studied. Expressions for the energy loss probability are obtained characterizing the solid by a spatial dispersive dielectric function $\varepsilon(\omega,k)$, within the well known specular reflection model and computations are performed for 100 keV electrons, using the Mermin dielectric function which includes both single particle and damped collective excitations in the medium. The study is focused on the variation of surface and bulk plasmon excitation probabilities with impact parameter, specially around the interface, at distances shorter than 10 Å.

7099 (CONF-8909210–, pp. 111-125) **On the Z_1^3 correction of the stopping power.** Nagy, I. (Univ. del Pais Vasco, San Sebastian (Spain)); Echenique, P.M. Oak Ridge National Lab., TN (United States). Apr 1990. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

Higher-order correction to the stopping power proportional to Z_1^3 is evaluated. The screening phenomenon of the bare projectile in an electron gas is characterized by simple Yukawa potentials. Second order Born approximation for the scattering amplitude is employed to describe the elastic collision cross section. For low velocity intruder a comparison of the analytical results with those obtained from a phase-shift calculation is made. For high velocity of the bombarding particle the final expression for the Z_1^3 correction corresponds to the classical result based on the polarization effect of a harmonic oscillator.

7100 (CONF-8909210–, pp. 153-173) **Dynamical effects in electron tunneling.** Sunjic, M. (Univ. of Zagreb, Croatia (Yugoslavia)); Marusic, L. Oak Ridge National Lab., TN (United States). Apr 1990. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

Recent advances in materials science, particularly in high precision fabrication (molecular beam epitaxy) of heterostructures and quantum wells with up to atomic monolayer precision, have led to rapid development of mesoscopic physics - studies of phenomena on a subnanometer scale. This paper will treat one particular aspect in the theory of electron tunneling in these structures: the role of dynamical screening and potentials in very thin barriers (e.g. doped Al Ga As layers). The model is based on the exact treatment of surface/interface plasmon excitations in layered structures and their nonlocal coupling to the electron current, and is solved in the WKB approximation. Analytic expression is obtained which contains the effects of screening dynamics, electron energy and decay, parallel velocity and recoil. Several cases are discussed, including self-consistent results and tunneling rates.

7101 (CONF-8909210–, pp. 175-182) **Photon scanning tunneling microscopy.** Warmack, R.J. (Oak Ridge National Lab., TN (United States)); Reddick, R.C.; Ferrell, T.L. Oak Ridge National Lab., TN (United States). Apr 1990. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

The PSTM is shown to be the photon analogue of the electron STM. In the PSTM, externally-supplied plane waves undergo total internal reflection at a dielectric interface. This creates an exponentially-decaying evanescent field adjacent to the interface. Photons can be made to tunnel to a nearby optically conducting fiber optic tip. The transmitted light signal is strongly dependence upon the tip to interface distance and can be regulated by feedback control to stabilize this distance. Perturbations caused by irregularities in the interface can therefore be imaged by scanning the tip laterally in the same way as STM. Subwavelength lateral and vertical resolution is demonstrated. Lateral resolution is governed by the decay of the evanescent field and the probe shape. Vertical resolution is governed by electrical and mechanical noise. Controllable parameters include the angle of incidence, wavelength, polarization, index of refraction, and probe shape. Direct imaging of standing waves caused by the interference of two coherent surface waves at the interface will also be shown.

7102 (CONF-8909210–, pp. 183-200) **Extended transfer Hamiltonian method for resonant tunneling.** Apell, S.P. (Umea Univ. (Sweden)); Albertson, E.; Penn, D.R. Oak Ridge National Lab., TN (United States). Apr 1990. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

A scheme originally due to Heitler is utilized in extending the transfer Hamiltonian description to resonant tunneling, for calculating transition probabilities and general frequency characteristics of tunneling coupled systems. The authors give examples for a single barrier in the context of the Scanning Tunneling Microscope and for a double barrier in connection with an irradiated quantum well. In this way they can very conveniently account for the saturation of the contact resistance in the STM and give a simple explanation for the high-frequency response in an irradiated double junction.

7103 (CONF-8909210–, pp. 201-210) **Laser field effects on the interaction of charged particles with degenerate and nondegenerate plasmas.** Arista, N.R. (Centro Atomico Bariloche (Argentina)); Galvao, R.M.O.; Miranda, L.C.M. Oak Ridge National Lab., TN (United States). Apr 1990. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

A general description of the effects of a strong laser field on the inelastic interaction between charged particles and a plasma is presented, both for classical (dilute) or quantum mechanical (dense)

plasmas. The dynamical response of the medium is recalculated, including the effects of the laser field, using a Dawson-Oberman transformation for classical systems, and the RPA formulation for quantum plasmas. The authors find that the energy exchange and the particle scattering rate are modified by multiphoton processes, and become anisotropic with respect to the direction of particle motion relative to the direction of laser polarization. The RPA formalism describes the excitation of plasmons and electron-hole pairs, with simultaneous emission or absorption of photons. They calculate the contribution of these processes to the energy exchange and to the mean-free path of the particle, in the range of a typical low density plasma, and in the range of solid-state electron densities. New effects due to the laser field become particularly important when the laser frequency becomes close to the plasma frequency. In this case, plasmon excitations can be produced below the normal velocity threshold through photon-assisted processes. This gives place to an anomalous low-velocity behavior of the stopping power.

7104 (CONF-8909210–, pp. 221-230) **Contribution of ripplon excitation to interaction energies of particulates.** Garcia-Molina, R. (Univ. de Murcia (Spain)); Barberan, N.; Gras-Marti, A. Oak Ridge National Lab., TN (United States). Apr 1990. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

Ripplons are quantized surface-tension waves in liquids. The authors have studied the contribution of virtual ripplon excitation: (1) to the image potential felt by a charge located in front of a liquid surface, and (2) to the van der Waals attraction between two liquid surfaces. These interactions have been investigated as a function of the distance between the interacting systems and for planar or spherical particulate geometry. The polar or non polar nature of the medium is also considered. The range of validity of the formulae derived is discussed.

7105 (CONF-8909210–, pp. 231-238) **q-dependent excitations of metal spheres.** Barberan, N. (Univ. de Barcelona (Spain)); Barranco, M.; Garcias, F.; Serra, L.; Navarro, J. Oak Ridge National Lab., TN (United States). Apr 1990. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

Bulk collective excitations on metallic spheres have been theoretically describes using a non-local dielectric function, a hydrodynamical model and a self-consistent time-dependent local density approximation. Here, the authors carry out a Random-Phase Approximation (RPA) sum rules (SR) calculation of the response (strength) function to multipole q-dependent operators of the type $j_L(qr)\ Y_{L0}$, where Y_{L0} is the spherical harmonic function and $j_L(qr)$ is the spherical Bessel function of order L. The results corresponding to the local operator $r^L\ Y_{L0}$ have already been discussed. They employ the spherical jellium model to describe the neutralizing positive background. The valence electron cloud of the unperturbed cluster is described either in the Kohn-Sham (KS) or an Improved Thomas-Fermi-Weizsaecker (ITFW) plus a local density approximation (Dirac+Wigner) for the exchange and correlation effects.

7106 (CONF-8909210–, pp. 267-271) **Target thickness dependent convoy electron production of aligned molecular HeH^+-ions.** Kemmler, J. (J.W. Goethe Univ., Frankfurt am Main (Germany)); Groeneveld, K.O.; Heil, O.; Kroneberger, K.; Rothard, H. Oak Ridge National Lab., TN (United States). Apr 1990. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

Many experiments have shown that the collective excitation of valence electrons effects the alignment and the stopping power of fast diatomic molecular ions penetrating thin solids. Collective excitations also seem to play an important role for the total electron emission induced by fast atomic and molecular ions. For a specific part of the overall electron distribution the convoy electrons, accompanying the projectile ion with equal speed and direction ($v_0 \approx v_p$), production mechanism had been proposed which attach their origin to the wake-potential. The authors presented a simple method for the detection of aligned diatomic molecular ions penetrating thin foils. Their first experimental results gave hints that the molecular enhancement for the convoy electron production of molecular ions is not simply a direct effect of the wake potential, but more contributed to the correlated action of the fast projectile ions in the solid.

7107 (CONF-8909210–, pp. 313-327) **Multiphonon energy exchange in the collision of an atom with a surface.** Manson, J.R. (Clemson Univ., SC (United States)); Ritchie, R.H. Oak Ridge National Lab., TN (United States). Apr 1990. DOE Contract AC05-84OR21400. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

The authors consider the collision of an atom with a surface under conditions where the energy transfer involves multiple phonons. Such conditions occur with either relatively high incident energies or hot surfaces. Several simple models for the energy exchange to the surface by a projectile with translational energy in the eV range show that such a particle should lose a large fraction of its energy upon collision. A more elaborate model, based on quantum mechanical transition matrix theory, agrees well with new experimental data for the scattering of low energy helium atoms with alkali halide surfaces.

7108 (CONF-8909210–, pp. 351-359) **Energy loss measurements of He and H scattered at grazing incidence off Ni.** Naermann, A. (Univ. of Osnabrueck (Germany)); Schmidt, K.; Imke, U.; Heiland, W. Oak Ridge National Lab., TN (United States). Apr 1990. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

The inelastic losses of a particle scattered from surfaces is determined by its charge state along the trajectory. Measurements using He and H at energies from 300 eV to 10 keV give information about the energy dependence and the peak shape of the energy spectra. The energy dependence is related to the velocity dependence of the electronic stopping power, the peak shape affords additional information about the charge state and the straggling.

7109 (CONF-8909210–, pp. 361-374) **Electronic response of metal surfaces to electron exchange with doubly charged ions.** Niehaus, A. (Rijksuniversiteit Utrecht (Netherlands)). Oak Ridge National Lab., TN (United States). Apr 1990. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

Electron spectra are discussed that arise from gazing incidence collisions of doubly charged keV-ions with single crystal surfaces at well defined angles of observation. New results are presented for doubly charged He, Ne, Ar colliding with a Ni(110)-surface, and are compared with corresponding results for a Cu(110)- surface reported earlier. Evaluation of the spectra in terms of the model developed in connection with the Cu-data confirms also for Ni the earlier conclusion that the metal surface responds delayed to the charge changing processes in front of it, with delay times of approximately 5×10^{-16}s. New results are also reported and discussed for the angular distribution of auto ionization electrons arising from doubly excited He- and Ne- atoms formed by capture of two surface electrons. It is found that these distributions are well described by the complex sub level population amplitudes of the corresponding decaying atomic states if a slight distortion by the charge- image charge interaction is taken into account. In the collision plane formed by the incoming beam and the surface normal

the distributions are found to be oriented parallel to the surface normal. Changes of electron spectra upon controlled chemisorption of oxygen atoms are discussed. Changes of the structures due to autoionization suggest that each autoionization line has a low energy satellite. This satellite is tentatively attributed to the excitation of a surface plasmon. Comparison with numerical calculations using existing formulae of linear response theory support this interpretation.

7110 (CONF-8909210–, pp. 375-387) **Transient adsorption, energy loss, and momentum transfer in low velocity ion surface scattering.** Snowdon, K.J. (Univ. o f Newcastle, New South Wales (Australia)); O'Connor, D.J.; Kato, M.; MacDonald, R.J. Oak Ridge National Lab., TN (United States). Apr 1990. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

Experimental evidence of transient adsorption or skipping motion of 200-2,000 eV Si^+ beams from a Cu(111) surface under angles of incidence from 1-20° is presented. Detailed analysis reveals that at all incident energies and angles, the highest energy loss peak of specularly scattered Si^+ and Si^- ions has suffered an energy loss equal to or exceeding the perpendicular energy of the incident beam to the surface. This would be sufficient to induce trapping by inelastic processes alone. Furthermore, the authors can deduce from the data that detrapping must occur through a combination of conservative processes and momentum transfer between the perpendicular and parallel momentum components of the beam to the surface. Unambiguous evidence for such coupling of the momentum components is provided by data for 50-200 eV Na^+ and K^+ scattering from the same surface. The origin of this coupling is explained.

7111 (CONF-8909210–, pp. 389-396) **The neutralization process of highly charged ions near a metal surface.** Folkerts, L. (Rijksuniversiteit Groningen (Netherlands)); Morgenstern, R. Oak Ridge National Lab., TN (United States). Apr 1990. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

During the neutralization of multicharged ions approaching a metal surface, a large number of secondary electron is ejected. Most of these electrons have low energies (<30 eV), but because of the great variety of processes leading to these low energy electrons, hardly any structure can be resolved in this part of the spectrum, and therefore it is difficult to deduce dependable information about the neutralization process. One possibility to circumvent this problem is to use multicharged ions which have an innershell hole, since neutralization of these ions results in the ejection of high energy electrons with more pronounced structures. The authors present high resolution energy spectra of electrons obtained from collisions of C^{5+}, N^{6+} and O^{7+} on a polycrystalline tungsten surface. They identify two structures in the spectra, at low energies the LMM Auger electrons, and at high energies the KLL Auger electrons, in which a substructure is resolved. The implications for the neutralization/deexcitation process are discussed.

7112 (CONF-8909210–, pp. 435-443) **Variation of DOSD moments with bond length in H_2 and N_2.** Oddershede, J. (Odense Univ. (Denmark)); Sabin, J.R.; Diercksen, G.H.F. Oak Ridge National Lab., TN (United States). Apr 1990. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

Using the polarization propagator formalism, the $S(\mu)$, $L(\mu)$ and I_μ ($-2 \leq \mu \leq 2$) moments of the DOSD of H_2 and N_2 are calculated. The dependence of these quantities on bond length is discussed, and the reliability of the results is evaluated. Finally, a comment is made on the possible connection between the bondlength variation of the mean excitation energy for stopping and the large phase effect in N_2: there isn't any.

7113 (CONF-8909210–, pp. 445-448) **The structure of ion induced secondary electron energy spectra from solids in forward direction.** Groeneveld, K. (Johann-Wolfgang-Goethe-Univ., Frankfurt am Main (Germany)); Maier, R.; Rothard, H. Oak Ridge National Lab., TN (United States). Apr 1990. (In English, German). From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

After a short introduction into the phenomenon of kinetic ion induced secondary electron emission from solids, the basic features of proton induced secondary electron spectra from thin foils in forward-(beam-) direction are briefly discussed.

7114 (CONF-8909210–, pp. 477-481) **Secondary electrons as probe of preequilibrium stopping power of ions penetrating solids.** Kroneberger, K. (J.W. Goethe Univ., Frankfurt am Main (Germany)); Rothard, H.; Koschar, P.; Lorenzen, P.; Groeneveld, K.O.; Clouvas, A.; Veje, E.; Kemmler, J. Oak Ridge National Lab., TN (United States). Apr 1990. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

The passage of ions through solid media is accompanied by the emission of low energy secondary electrons. At high ion velocities v_p (i.e. $v_p > 10^7$ cm/s) the kinetic emission of electrons as a result of direct Coulomb interaction between the ion and the target electron is the dominant initial production mechanism. The energy lost by the ion and, thus, transferred to the electrons is known as electronic stopping power in the solid. Elastic and inelastic interactions of primary, liberated electrons on their way through the bulk and the surface of the solid modify strongly their original energy and angular distribution and, in particular, leads to the transfer of their energy to further, i.e. secondary electrons (SE), such that the main part of the deposited energy of the ion is eventually over transferred to SE. It is, therefore, suggestive to assume a proportionality between the electronic stopping power S_e of the ion and the total SE yield g, i.e. the number of electrons ejected per ion. Following Sternglass the authors consider schematically for kinetic SE emission contributions from two extreme cases: (a) SEs produced mostly isotropically with large impact parameter, associated with an escape depth L_{SE} from the solid; (b) SEs produced mostly unisotropically in forward direction with small impact parameter (δ-electrons), associated with a transport length L_δ.

7115 (CONF-8909210–, pp. 483-487) **Secondary electron emission with molecular projectiles.** Kroneberger, K. (J.W. Goethe-Univ., Frankfurt am Main (Germany)); Rothard, H.; Koschar, P.; Lorenzen, P.; Kemmler, J.; Keller, N.; Maier, R.; Groeneveld, K.O.; Clouvas, A.; Veje, E. Oak Ridge National Lab., TN (United States). Apr 1990. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

The authors present results for the secondary electron emission (SEE) from thin foil targets, induced by both molecular ions and their atomic constituents as projectiles. The Sternglass theory for kinetic SEE states a proportionality between γ and the electronic stopping power, S_e, which has been verified in various experiments. With comparing secondary electron (SE) yields induced by molecular projectiles to those induced by monoatomic projectiles, it is therefore possible to test models for the energy loss of molecular or cluster projectiles. Since the atomic constituents of the molecule are repelled from each other due to Coulomb explosion (superimposed by multiple scattering) while traversing the solid, it is interesting to measure the residual mutual influence on SEE and S_e with increasing internuclear separation. This can only be achieved with thin foils, where (as in the present case) the SE-yields from the exit surface can be measured separately. The authors measured the SE-yields from the entrance (γ_B) and exit (γ_F) surfaces of thin C- and Al-foils (150 to 1,000 Å) with CO^+, C^+ and O^+ (15 to 85 keV/u) and H_2^+ and H^+ (0.3 to 1.2 MeV/u). The

molecular effect defined as the ratio R(γ) between the yields induced by molecular projectiles and the sum of those induced by their atomic constituents was calculated. The energy dependence of R(γ) can be well represented by the calculated energy loss ratio of di-proton-clusters by Brandt. This supports Brandt's model for the energy loss of clusters.

7116 (CONF-8909210–, pp. 489-505) **Direction-dependent stopping power and beam deflection in anisotropic solids.** Crawford, O.H. (Oak Ridge National Lab., TN (United States)). Oak Ridge National Lab., TN (United States). Apr 1990. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

Directional effects on the motion of swift ions in anisotropic media are studied. The stopping power is a function of the direction of the velocity relative to the principal axes of the medium, and there is a nonzero lateral force on the ion tending to bend its trajectory. These effects arise from the anisotropy of the dielectric response, and are distinct from channeling. Simple expressions are derived for the stopping power and lateral force in the nonrelativistic, high-velocity limit, and results are presented for crystalline graphite.

7117 (CONF-8909210–, pp. 517-532) **Bremsstrahlung induced by 50 MeV H^0 bombardment.** Stein, C. (Weapons Lab., Kirtland AFB, NM (United States)); Habiger, K.W.; Smith, B.R.; Crawford, O.H.; Ritchie, R.H. Oak Ridge National Lab., TN (United States). Apr 1990. DOE Contract AC05-84OR21400. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

Three different thicknesses of aluminum targets, 0.0025 cm, 0.025 cm, and 0.32 cm were irradiated with 50-MeV neutral hydrogen atoms and the resultant bremsstrahlung radiation measured. The experimental results are compared with calculations that include bremsstrahlung by the projectile's electron and its cascade, bremsstrahlung by the cascade electrons that are generated by the projectile nucleus and quasifree-electron bremsstrahlung. The theoretical and experimental values of the total yield agree within a factor of three for all target thicknesses and all bremsstrahlung energies.

7118 (CONF-8909210–, pp. 533-535) **Excited substates mixing of fast heavy ions in solids.** Rozet, J.P. (Univ. P.M. Curie, Paris (France)); Chetioui, A.; Wohrer, K.; Stephan, C.; Ben Salah, F.; Touati, A.; Politis, M.F.; Vernhet, D. Oak Ridge National Lab., TN (United States). Apr 1990. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

Recently, anomalous population of capture nl sublevels of Kr^{35+} ions emerging from thin solid foils has been reported (1). This effect was tentatively interpreted on the basis of a Stark mixing in the wake electric field of the moving ion ($\simeq 10^9$V/cm for 35 Mev/u Kr^{35+} ions in C). Such a field has been quantitatively observed in a plasma source. However, in solid medium, only partial evidence of this phenomenon has been given, through experiments on molecular dissociation and energy splitting of excited states of ions in solids. In any case a possible modification of collisional processes in solids by a wake electric field has to be investigated. Some outcomes have been identified for testing; these include, among other effects, a difference of the polarization of the light emitted by ions emerging from gaseous or solid targets. The authors have measured the angular distributions of the 2P $\rightarrow$ 1S transition following electron capture of 35 MeV/u Kr^{36+} ions in various gaseous and solid media. Polarizations of the Lyman α-X-rays emitted by projectiles after capture have been extracted from the best fit of their measured angular distributions. They note a good agreement between experimental and theoretical values in the case of gas targets. On the other hand a definite solid-gas difference is observed. These differences in relative intensities and polarization of Lyman transitions can be qualitatively explained by a wake electric field-induced Stark mixing of excited sublevels.

7119 (CONF-8909210–, pp. 551-571) **Interaction of low-energy electrons and positrons with condensed matter: Stopping powers and inelastic mean free paths from optical data.** Ashley, J.C. (Oak Ridge National Lab., TN (United States)). Oak Ridge National Lab., TN (United States). Apr 1990. DOE Contract AC05-84OR21400. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

An 'optical-data model' is described for evaluating energy loss per unit pathlength and inelastic mean free path for low-energy electrons and positrons ($\simeq$ 10 keV) from optical data on the medium of interest. Exchange between the incident electron and electrons in the medium is included. Results from the optical-data model are compared with previous theoretical calculations.

7120 (CONF-920948–10) **Theory of electron ejection from surfaces by highly charged ion impact.** Ovchinnikov, S.Y. (Tennessee Univ., Knoxville, TN (United States)); Macek, J. Oak Ridge National Lab., TN (United States). [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 6. international conference on physics of highly charged ions; Manhattan, KS (United States); 28 Sep - 2 oct 1992. Order Number DE93004109. Source: OSTI; NTIS; INIS; GPO Dep.

The purpose of this work is to present a simple model for electron production in ion-surface collisions, and to develop expressions for the electron energy distribution based on this model.

7121 (INIS-mf–13204, pp. 150-153) **Nitrogen implantation in steel with an impulsive ion implanter.** Feugeas, J.N. (Rosario Univ. Nacional (Argentina). Inst. de Fisica); Gonzalez, C.O.; Hermida, J.; Nieto, M.; Peyronel, M.F.; Sanchez, G. Comision Nacional de Energia Atomica, Buenos Aires (Argentina); International Atomic Energy Agency, Vienna (Austria); Secretaria de Ciencia y Tecnica, Buenos Aires (Argentina). 1990. [368] (CONF-900739–: 4. Latin American workshop on plasma physics, Buenos Aires (Argentina), 16-27 Jul 1990). In *Fourth Latin-American workshop on Plasma Physics (held in) Buenos Aires, Argentina, 16-27 Jul 1990. Contributed papers.* Order Number DE92635466. Source: OSTI; NTIS (US Sales Only); INIS.

This work describes the results of steel implantation with nitrogen, with a pulsed accelerator which provides a continuous ion energy spectrum giving a uniform profile of nitrogen without changing its operative conditions. (Author).

7122 (INIS-mf–13204, pp. 158-160) **Steel surface heating by pulsed ion beam irradiation.** Feugeas, J.N. (Rosario Univ. Nacional (Argentina). Inst. de Fisica); Sanchez, G. Comision Nacional de Energia Atomica, Buenos Aires (Argentina); International Atomic Energy Agency, Vienna (Austria); Secretaria de Ciencia y Tecnica, Buenos Aires (Argentina). 1990. [368] (CONF-900739–: 4. Latin American workshop on plasma physics, Buenos Aires (Argentina), 16-27 Jul 1990). In *Fourth Latin-American workshop on Plasma Physics (held in) Buenos Aires, Argentina, 16-27 Jul 1990. Contributed papers.* Order Number DE92635466. Source: OSTI; NTIS (US Sales Only); INIS.

The temperature evolution under the surface of a steel target during the nitrogen ion beam irradiation with a 1 kJ Plasma Focus, was studied using finite differences calculations. A continuous ion energy spectral law, a 200 ns emission lasting time and a 40deg C solid angle geometry were used as Plasma Focus ion beam characteristics. The steel fusion temperature is reached up to 0.25 μm depth for a target located at 35 mm from the focus. No fusion temperature is reached for distances larger than 100 mm. (Author).

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Refer also to citation(s) 5923, 6061

7123 (LA-UR–92-3237) **Dynamics and photoexcitation in MX and MXX′ chain solids.** Gammel, J.T. (Naval Command, Control and Ocean Surveillance Center, San Diego, CA (United States)); Saxena, A.; Bishop, A.R. Los Alamos National Lab., NM (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9208132–3: 1992 international conference on science and technology of synthetic metals (ICSM), Goeteborg (Sweden), 12-18 Aug 1992). Order Number DE93003691. Source: OSTI; NTIS; INIS; GPO Dep.

Nonlinear adiabatic dynamics associated with nonlinear excitations in MX and MXX′ chain materials are numerically studied within a discrete, 3/4-filled, two-band, tight-binding extended Peierls-Hubbard model. Both Hartree-Fock (HF) adiabatic molecular relaxation and molecular dynamics techniques are employed to investigate the time evolution of solitons, polarons, bipolarons in charge-density-wave (CDW), bond-order-wave (BOW) and spin-density-wave (SDW) ground state materials. Photoexcitations are performed between (i) continuum levels, (ii) localized levels, (iii) continuum and localized levels. The subsequent formation and time evolution of excitons, defect pairs, breathers, and, for the MXX′ solids, charge separation are studied in terms of energy levels and distortion patterns. These results are compared with the dynamics of previously studied 1/2-filled, one-band, SSH-type electron-phonon models, used for studying polyenes and polyynes, and experimental data.

7124 (LBL–32901) **Response of a $Nb/Al_2O_3/Nb$ tunnel junction to picosecond electrical pulses.** Karadi, C (Lawrence Berkeley Lab., CA (United States)); Verghese, S.; Mears, C.A.; Orenstein, J.O.; Richards, P.L.; Barfknecht, A.T. Lawrence Berkeley Lab., CA (United States). Sep 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-930150–1: Optical Society of America (OSA) meeting on ultrafast optics and optoelectronics, San Francisco, CA (United States), 25-27 Jan 1993). Order Number DE93002625. Source: OSTI; NTIS; GPO Dep.

Picosecond electrical pulses were used to measure the broadband quasiparticle response of a Nb trilayer SIS (superconductor-insulator-superconductor) junction in both the linear and nonlinear regimes. The electrical pulses were generated by illuminating a Si photoconducting switch using a Ti-sapphire laser. The SIS response is inferred by measuring the dc current induced by interfering two electrical pulses at the junction, as a function of the time delay between them. Results are obtained for bias voltages of 1.0 and 2.0 mV; at the latter, two-photon absorption was detected.

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Refer also to citation(s) 5999, 6001, 6012, 6020, 6029, 6089, 6314, 6321, 6322, 6325, 6343, 6344, 6347, 6348, 6351, 6361, 6362, 6412, 6819, 6827, 6828, 6829, 6853, 6863, 7068, 7124, 7166

7125 (ANL/CP–77532) **Melt processing of the $Bi_2Sr_2CaCu_2O_y$ superconductor in oxygen and argon atmospheres.** Holesinger, T.G. (Argonne National Lab., IL (United States)); Miller, D.J.; Chumbley, L.S. Argonne National Lab., IL (United States). Aug 1992. 5p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract W-31109-ENG-38 ;W-7405-ENG-82. Contract DMR-8809854. (CONF-920802–31: Applied superconductivity conference, Chicago, IL (United States), 23-28 Aug 1992). Order Number DE93002999. Source: OSTI; NTIS; INIS; GPO Dep.

Solidification and subsequent annealing of $Bi_2Sr_2CaCu_2O_y$ (2212) in oxygen and argon atmospheres were investigated in order to identify alternative processing routes for controlling microstructures and superconducting properties. In addition to 2212, several other phases formed on cooling in O_2 and did not disappear upon subsequent annealing. Crystallization in Ar resulted in a divorced eutetic structure of $Bi_2Sr_{3-x}Ca_xO_y$ and Cu_2O/CuO. The superconductor was formed on subsequent anneals. Samples melted in Ar and then annealed generally possessed a more uniform microstructure compared with samples that were melted in oxygen and annealed. Compositional measurements of the 2212 phase suggest that CaO segregation in the melt may be minimized with an overall composition such as $Bi_{2.15}Sr_2Ca_{0.85}Cu_2O_y$.

7126 (ANL/MCT/CP–76909) **Processing and microstructural development of Ag-clad Bi-Sr-Ca-Cu-O tapes.** Poeppel, R.B. (Argonne National Lab., IL (United States)); Goretta, K.C.; Balachandran, U.; Biondo, A.C.; Dorris, S.E.; Hathcox, S.C.; Kaufman, D.Y.; Lanagan, M.T.; Prorok, B.C.; Wu, C.T.; Hu, J.G.; Holesinger, T.G.; Miller, D.J. Argonne National Lab., IL (United States). Materials and Components Technology Div. Oct 1992. 5p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract W-31109-ENG-38. Contract DMR 88-09854. (CONF-9211144–1: 5. United States/Japan workshop on high T_c superconductors, Tsukuba (Japan), 9-10 Nov 1992). Order Number DE93004201. Source: OSTI; NTIS; INIS; GPO Dep.

Ag-clad $Bi_2Sr_2CaCu_2O_x$ (2212) and $(Bi,Pb)_2Sr_2Ca_2Cu_3O_x$ (2223) tapes were fabricated by drawing and rolling. Highly textured microstructures and high critical current density values were obtained for each system. However, the heat treatments and phase evolutions for 2212 and 2223 were different. For 2212, nearly phase-pure powder was used, and the heat treatments consisted of partial melting followed by solid-state sintering. For 2223, several compositions, initial phases, and sintering schedules were used. Results are discussed in terms of microstructural evolution as observed by X-ray diffraction and scanning and transmission electron microscopy.

7127 (BNL–47369) **The effects of heavy-ion irradiation of superconductivity in $YBa_2Cu_3O_7$ epitaxial films.** Budhani, R.C.; Zhu, Y.; Suenaga, M. Brookhaven National Lab., Upton, NY (United States). [1992]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-920802–28: Applied superconductivity conference, Chicago, IL (United States), 23-28 Aug 1992). Order Number DE93002325. Source: OSTI; NTIS; GPO Dep.

We report a comparative study of the superconducting behavior in YBa^2Cu^3O7 epitaxial films irradiated with Ag and Au ions of several hundred MeV energy. The irradiation results in columnar defects of average diameter $\sim$ 55 and $\sim$110 Å for Ag^{+21} and Au^{+24} ions respectively. A universal linear scaling is observed between the fractional areal damage vs the superconducting transition temperature and normal state resistivity. Our results also show that in these films with intrinsically strong pinning, a marginal enhancement in the critical current density (J_c) occurs when the defect density is $\leq 5 \times 10^{10}/cm^2$ and the defect diameter is of the order of coherence length. This criterion is satisfied by the silver ions. The damage due to Au^{+24} ions is much too severe to improve the J_c.

7128 (DOE/ER/45266–T3) **Study of high $T_c$superconducting thin films grown by MOCVD: Final report, July 1, 1986–April 30, 1990.** Erbil, A. Georgia Inst. of Tech., Atlanta, GA (United States). School of Physics. [1990]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-86ER45266. Order Number DE93005052. Source: OSTI; NTIS; GPO Dep.

Work is described briefly, which was carried out on development of techniques to grow metal-semiconductor superlattices (artificially layered materials) and on the copper oxide based superconductors (naturally layered materials). The current growth technique utilized is metalorganic chemical vapor deposition (MOCVD). CdTe, PbTe, La, LaTe, and Bi_2Te_3 were deposited, mostly on GaAs. Several $YBa_2Cu_3O_7$ compounds were obtained with possible superconductivity at temperatures up to 550 K (1 part in 10^4). $YBa_2Cu_3O_{7-x}$ and $Tl_2CaBa_2Cu_2O_y$ thin films were deposited by MOCVD on common substrates such as glass.

7129 (DOE/ER/45427–3) **Midwest Superconductivity Consortium: Progress report, 1992.** Bement, A.L. Jr. Purdue Univ., Lafayette, IN (United States). Jan 1993. 65p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER45427. Order Number DE93006146. Source: OSTI; NTIS; GPO Dep.

Mission of the Midwest Superconductivity Consortium, MISCON, is to advance the science and understanding of high Tc superconductivity. Programmatic research focuses upon key

materials-related problems; principally, synthesis and processing and properties limiting transport phenomena. During the past year, 26 projects produced over 133 talks and 113 publications. publications. Two Master's Degrees and one Ph.D. were granted to students working on MISCON projects. Group activities and interactions involved two MISCON group meetings (held in July and January), twenty external speakers, 36 collaborations, 10 exchanges of samples and/or measurements, and one (1) gift of equipment from industry. Research achievements this past year expanded our understanding of processing phenomena on structure property interrelationships and the fundamental nature of transport properties in high-temperature superconductors.

7130 (ETDE/JP-mf–93753763, pp. 190-212) **Principle of superconduction.: Historical development of superconduction and its physical significance.** Otsuka, Y. (Tohoku University, Sendai (Japan)). Cryogenic Association of Japan, Tokyo (Japan). [1991]. 606p. (In Japanese). In *Proceedings of the 1st-4th cryogenic engineering summer seminar (1988-1991).* Order Number DE93753763. Source: OSTI; NTIS (US Sales Only).

The superconduction was phenomenologically investigated. The basic theory of superconduction is the BCS theory. That theory gave a microscopic ground to the phenomenology by London and Ginzburg-Landau, arranged a foundation to discover the Josephson effect and served for deepening the comprehension of superconduction No.2. That theory also gave a considerably good result to the elucidation of liquid helium in superfluid state, atomic structure, etc.. Many types of superconductive substance had been discovered since the BCS establishment and thereafter, a large impact was given by the discovery of high critical temperature oxide superconductors. It is judged that the BCS is unable to explain the high critical temperature from 30K to higher than 100K shown by the oxide superconductor. The same as the conventional superconductor, that superconductor shows a quantization in magnetic flux with an electric charge of which the unit is 2e. It proves BCS 's hypothesis of electronic pair to be valid, however with a problematic fact that the pair state is not simply describable. The oxide superconductor considerably varies in different properties even by a slight difference in composition. If such a difficalty can be eliminated, the application will make a further progress. 10 figs.

7131 (ETDE/JP-mf–93753763, pp. 213-232) **Pinning phenomenon of superconduction.: How to heighten J_c of high temperature superconduction.** Matsushita, T. (Kyushu University, Fukuoka (Japan). Faculty of Engineering). Cryogenic Association of Japan, Tokyo (Japan). [1991]. 606p. (In Japanese). In *Proceedings of the 1st-4th cryogenic engineering summer seminar (1988-1991).* Order Number DE93753763. Source: OSTI; NTIS (US Sales Only).

Pinning being investigated of both low temperature practical use materials and high temperature superconductors, study was made of how to heighten the critical current density (J_c). The mechanism of magnetic flux pinning enables the steady current to flow without electric resistance. The heightening in J_c is made by heightening the pinning force density through strengthening each pin and heightening its concentration. Low temperature practical use materials, Nb-Ti and Nb_3Sn have been designed to heighten the J_c by shaping the α-Ti into a thin ribbon and making the crystalline grain diameter small, respectively. Such a metallurgical process to make the pin of low temperature material is not intactly applicable to the high temperature oxide superconductor. Process which is taken notice of is the thin film method with an parallel orientation of C-axis to the substrate or melting method which aims at eliminating the interface by a weak bonding. It cannot but be admitted that the influence of magnetic flux creep is very large even if the J_c becomes high. However, the damping of permanent current can be avoided by heightening the safety factor. 30 refs., 15 figs.

7132 (ETDE/JP-mf–93753763, pp. 233-248) **Magnet technology. Part 1.: Base of coil preparation.** Maeda, H. (Toshiba Corp., Tokyo (Japan)). Cryogenic Association of Japan, Tokyo (Japan). [1991]. 606p. (In Japanese). In *Proceedings of the 1st-4th cryogenic engineering summer seminar (1988-1991).* Order Number DE93753763. Source: OSTI; NTIS (US Sales Only).

The present report explained the basic superconducting magnet coil technology. As for the wire materials NbTi and Nb_3Sn are used below and above 8T, respectively. The critical current of coil is determined from the intersection of two relation curves, i.e., critical current of wire vs. magnetic field and current of coil vs. highest magnetic field of coil. Quenching occurs by the current of coil if stronger than its above critical current. Because the magnetic field is weak on the outer circumference of coil4 the coil can be miniaturized by using thin wire to heighten the current density. In the coil, both the forces, i.e., internal pressure directed radially toward its outside and compression done from both its top and bottom vertically toward its middle section work so that it must be mechanically designed to resist them. Stabilizing materials are sufficiently added to the conductor to have the coil revert with stability from the quenching due to the disturbance. Mechanical measures are also taken to prevent the quenching from being caused by the movement of wire. In order to prevent the ordinary conduction part from quickly heightening in temperature, protective resistance is introduced by separating the coil from the electric source usually by a breaker and the current is then damped with enforcement. The excitation test was also explained. 20 refs., 18 figs., 3 tabs.

7133 (ETDE/JP-mf–93753763, pp. 249-270) **Magnet technology. Part 2.: Application of finite element method.** Ishiyama, A. (Waseda University, Tokyo (Japan). School of Science and Engineering). Cryogenic Association of Japan, Tokyo (Japan). [1991]. 606p. (In Japanese). In *Proceedings of the 1st-4th cryogenic engineering summer seminar (1988-1991).* Order Number DE93753763. Source: OSTI; NTIS (US Sales Only).

The present paper generally explained the numerical field analysis which was mainly a finite element method to be used for the superconducting magnet design and characteristic analysis. A simultaneous use of both finite and boundary element methods is effective in analyzing the electromagnetic field and so generalized as to be able to reply to problems of non-linearity, vortex current and closed domain. Because of a domain method, the finite element method handles the infinite space, while the boundary element method plays a complementary role for the leakage analysis of magnetic field. A formulation was shown by using cylindrical coordinates for an example of magnetic resonance imaging use superconducting magnet equipped with magnetic shields. The finite element method was applied into the places where a magnetic shield existed, while the boundary element method was done into the central part including the wire winding part and infinite space domain. By thus doing the above, the non-linearity of magnetization characteristics could be taken into consideration of iron and the external leakage of magnetic field was analyzed also easily. Actual examples were further introduced of thermal contraction at the time of cooling, stress due to the electromagnetic force at the time of excitation and deformation analysis. Also in the immersion cooling method, the propagation characteristics of normal conduction were formulated by a finite element method analysis in the two-dimensional field. 16 refs., 18 figs., 1 tab.

7134 (ETDE/JP-mf–93753763, pp. 271-282) **Technology for stabilizing superconducting coil.: Upper limit of heightening of current density.** Onishi, T. (Electrotechnical Laboratory, Tsukuba (Japan)). Cryogenic Association of Japan, Tokyo (Japan). [1991]. 606p. (In Japanese). In *Proceedings of the 1st-4th cryogenic engineering summer seminar (1988-1991).* Order Number DE93753763. Source: OSTI; NTIS (US Sales Only).

From the viewpoint of heightening the current density, the present report generally explained the stabilization technology of superconducting coil. The concept of stability is classified into whether or not the coil transits between the superconduction (S) and normal conduction (N), whether or not it can reverse after the S-N transition and whether or not it is damaged by the quenching. The degree of disturbance is a problem raised by the design concept which tolerates the quenching a certain extent. Without any other distrubance than the magnetic instability, the Nb_3 Sn wire is stable up to $2.8\times10^9 A/m^2$ at 6T. Though considerably lowered actually by the line displacement disturbance, the current density is heightened by narrowing the disturbance space to the minimum propagation zone. The floating train attains to $10^8 A/M^2$. Though lowered to the order of $10^7 A/m^2$ in the design concept of perfect stabilization, the current density can be expected to be $10^8 A/m^2$ by heightening the cooling heat flow flux, enlarging the transfer face and applying the

high critical temperature materials. Though controlled also from the mechanical safety, the current density is heightened through the engineering of improving the voltage-resistant characteristics, heightening the current of conductor and controlling the coil separately and independently. 10 refs., 12 figs., 2 tabs.

7135 (ETDE/JP-mf–93753763, pp. 283-305) **Fundamentals of application of large superconducting magnet.** Funaki, K. (Kyushu University, Fukuoka (Japan). Faculty of Engineering). Cryogenic Association of Japan, Tokyo (Japan). [1991]. 606p. (In Japanese). In *Proceedings of the 1st-4th cryogenic engineering summer seminar (1988-1991).* Order Number DE93753763. Source: OSTI; NTIS (US Sales Only).

The present report summarized the design guidance and problems of large superconducting magnet. Measures to prevent the superconducting wire from quenching are to control the cause (disturbance) of heightening in temperature, remove the thermal generation by the disturbance, prevent the normal conduction from transiting and reverse it to a superconductive state by the cooling after the transition. Measures against the instability due to the magnetic flux jump and AC loss of internally caused disturbance consist of dynamical stabilization and facial cooling in order to control the magnetic diffusion in the tape conductor as well as the thinning in core of multi-core wire. Contrary against the externally caused disturbance such as the conductor movement and structural breaking due to the electromagnetic force in the coil, measures are of an immersion cooling method, which further calls for the supercritical pressure helium to be used in the internal cooling method or superfluidized helium cooling method. Protective measures were also explained against the quenching. Accumulated energy being necessary in the daily load adjustment use SMES, the economical performance taking the quantity into consideration of superconductive materials is important with a possible design of thin wall solenoid which supports the radial stress by rock mass. Simultaneous heightening in both mean load current density of conductor and critical current density characteristics of superconductor is effective in lowering in cost for the conductor which is a costwise important portion. Such being the case, it is important to improve the stabilization and anti-quenching protective technology, and develop the superconductive materials. 20 refs., 18 figs., 3 tabs.

7136 (ETDE/JP-mf–93753763, pp. 333-351) **Superconducting computer.** Hayakawa, H. (Nagoya University, Nagoya (Japan). Faculty of Engneering). Cryogenic Association of Japan, Tokyo (Japan). [1991]. 606p. (In Japanese). In *Proceedings of the 1st-4th cryogenic engineering summer seminar (1988-1991).* Order Number DE93753763. Source: OSTI; NTIS (US Sales Only).

The superconducting Josephson computer technology was explained in both present and future statuses. Through the development of Nb system integration technology, it is engineered to improve the junction characteristics and innovate the integration process so that an LSI containing several thousands of gates is on the point of being completely structured. The logic circuit is structured on basis of a logical gate which is of either SQUID type or direct coupling type. The highest obtained speed is as high as 1.5ps/gate. The memory circuit utilizes a permanent current flowing in the superconducting loop. The cell has succeeded in gaining access by 98% with a memory cell method of variable threshold value. Coming to stably operate also as a microprocessor, the subject computer is 10 times as high in speed as the GaAs system one. As having no interchangeability with the conventional semiconductor system because of a complete difference in operational principle and supercold temperature operation, the Josephson computer is prevented from being put to practical use. A computer system may be structured if the high speed Josephson computing part put in liquid helium is connected to a large semiconductor capacity memory at 77K by using a high speed stripline of high temperature superconductor. The subject computer excels all the other semiconductor elements in highness in speed and lowness in power consumption. 33 refs., 14 figs., 3 tabs.

7137 (ETDE/JP-mf–93753763, pp. 352-366) **AC application of superconduction.** Ito, T. (Toshiba Corp., Tokyo (Japan)). Cryogenic Association of Japan, Tokyo (Japan). [1991]. 606p. (In Japanese). In *Proceedings of the 1st-4th cryogenic engineering summer seminar (1988-1991).* Order Number DE93753763. Source: OSTI; NTIS (US Sales Only).

The present report explained the R and D of superconduction for the AC application. The generated magnetic field of superconducting transmission line is so weak that the AC loss can be reduced if it is used in the Meissner domain. Many designs calling for Nb, first class superconductor, there are also materials which are not only stabilizing materials such as Cu and Al, but also lined with NbTi or Nb^3Sn for a possible flowing of strong current at the time of accident. Though small scale experiments are being successfully made, the large scale development is interrupted because of dullness in power consumption. The superconducting transformer can give current density which is more than 10 times as high as that done by the conventional one. The use of multi-superthin core wire may be able to make the AC loss lower than the conventional copper loss and heighten the transforming efficiency. However, it has an only problem of taking measures for the reversion after the quenching of transformer. Though the large capacity short circuit current limiting unit is presently not put to practical use, proposal is made of superconductive current limiting unit. Utilization is made of heightening in resistance by the transition of normal conduction. It is necessary to develop AC superconductor provided with a large capacity and small loss for the AC application of superconduction. It is also important to heighten the efficiency of refrigeration system. 25 refs., 18 figs., 3 tabs.

7138 (ETDE/JP-mf–93753763, pp. 441-445) **Principle and actual use of low temperature structural materials.** Yoshimura, H. (Mitsubishi Electric Corp., Tokyo (Japan)). Cryogenic Association of Japan, Tokyo (Japan). [1991]. 606p. (In Japanese). In *Proceedings of the 1st-4th cryogenic engineering summer seminar (1988-1991).* Order Number DE93753763. Source: OSTI; NTIS (US Sales Only).

The cryogenic structural materials are explained with an example of superconducting generator. Those are the materials which are not brittle but sufficiently strong at cryogenic temperature. The superconducting generator is composed of field coil as a rotor and armature coil as a stator. As it is maintained at cryogenic temperature, its field coil is integrated internally with a He tank and refrigerated by liquid He. The He tank is supported by the rotor through a torque tube. As able to generate a strong magnetomotive force, the superconducting field coil is not needed to be equipped with an iron core, while the non-magnetic materials attaching importance to the low temperature strength are used for the structural members of rotor. The torque tube is a member which connects the normal temperature shaft to a coil-fitting shaft maintained in a cryogenic state and transfers torque between the shaft and field coil. It is important to quantitatively decrease the heat invading the cryogenic part from the normal temperature part for which refrigeration by gaseous He is made by using materials, low in thermal transfer coefficient. The present report also explained the support structure of field coil and that of armature coil. Without lowering in impact strength even at He temperature the stainless steel excels in both processability and weldability, and is widely used. 5 refs., 10 figs.

7139 (ETDE/JP-mf–93753763, pp. 446-465) **Reliability and evaluation technology of low temperature structural materials.** Ogata, T. (National Research Institute for Metals, Tsukuba (Japan)). Cryogenic Association of Japan, Tokyo (Japan). [1991]. 606p. (In Japanese). In *Proceedings of the 1st-4th cryogenic engineering summer seminar (1988-1991).* Order Number DE93753763. Source: OSTI; NTIS (US Sales Only).

Summarizing the mechanical characteristics of low temperature materials, the present report explained the test method and evaluation technology. Though the required properties differ dependently upon the purpose of use, factors in question are the strength, low temperature brittleness which is a property of becoming hard and brittle with lowering in temperature, and particularly, dependency of fracture toughness upon temperature. With lowering in temperaturer the austenitic stainless steel heightens in yield stress and tensile strength, and generally lowers in reduction of area, impact value and fracture toughness. Though differing materially, both the fatigue and cracking propagation characteristics are determinated by a balance between the heightening in strength and lowering in ductility. The reliability evaluation of materials requires a test on the

mechanical characteristics at liquid He temperature, which test is however accompanied with handling of liquid He, accuracy in strain measurement, operational control of bending tester, serration behavior in deformation and other difficulties. However at present, it is no longer very difficult to obtain data of fatigue, impact, toughness, etc. Tensile and other tests have become simple with a small cryostat. The report also introduced the trend of standardizing the test method and new standard test method. 33 refs., 21 figs., 4 tabs.

7140 (ETDE/JP-mf–93753763, pp. 466-479) **Principle of SQUID.** Iguchi, I. (University of Tsukuba (Japan)). Cryogenic Association of Japan, Tokyo (Japan). [1991]. 606p. (In Japanese). In *Proceedings of the 1st-4th cryogenic engineering summer seminar (1988-1991).* Order Number DE93753763. Source: OSTI; NTIS (US Sales Only).

The present report explained the principle of superconducting quantum interference device (SQUID) which utilizes a Josephson quantum interference effect caused by the superconductor as existing in a macroscopic quantum state. In the tunnel junction which inserts a thin insulation layer between two superconductors, Cooper electron pair tunnels and Josephson current flows without generation of voltage between both ends of junction. In the superconducting loop (dc SQUID) which is connected in parallel with two Josephson junction devices prepared with oxide high temperature superconductor, the highest value of total current changes with a period of ϕ_O(unit of fluxoid quantum) against the magnetic flux which penetrates the loop by a superconducting quantum interference effect. Very small magnetic flux can be measured by counting the ϕ_O which is extremely small in value. Even in case of one device, the connection with an AC (rf) resonance circuit can have it operate in the same manner as that in case of dc SQUID, i.e., the output periodically changes withϕ against the external magnetic flux. It is called rf SQUID. The report also explained operational examples of SQUID using the oxide high temperature superconductor. 14 refs., 15 figs.

7141 (ETDE/JP-mf–93753763, pp. 499-510) **Measurement by SQUID.** Kado, H. (Electrotechnical Laboratory, Tsukuba (Japan)). Cryogenic Association of Japan, Tokyo (Japan). [1991]. 606p. (In Japanese). In *Proceedings of the 1st-4th cryogenic engineering summer seminar (1988-1991).* Order Number DE93753763. Source: OSTI; NTIS (US Sales Only).

The biological micromagnetic field measurement system being taken as an example, the present report explained different side views in case of measuring the micromagnetic field by integrating the superconducting quantum interference device (SQUID) into a system. In the superconducting ring, DC (bias current) flows between both electrodes which insert two Josephson junctions (JJ) between them. When the magnetic field tends to invade the inside of ring, a shielding current flows to prevent it. Voltage is generated between both electrodes because due to the relation between the directious of current, difference is given in flowing current between those two JJs (as an interference effect in the wave properties of superconducting electron pair). Even with a very weak magnetism, generated is a high voltage. The voltage changing periodically against the magnetic flux, the magnetic flux corresponding to such a periodicity is a physical constant which is called fluxoid quantum and does not depend upon the superconductor. The magnetic flux is measured as an integer multiple of that constant. The report also explained the structure and operational method of SQUID fluxmeter, and insulation and removal of magnetic noise. Because the inside of biological body is presumed from data on the external magnetic field generated by the activity inside that body, it is impossible in principle to obtain the optimized solution. However, it is possible to comprehend the inside of biological body with various hypotheses, characteristic knowledge a priori and other supports. 9 refs., 14 figs., 1 tab.

7142 (INIS-mf–14101) **Alternative superconducting systems.** Max-Planck-Institut fuer Festkoerperforschung, Stuttgart (Germany); Bundesministerium fuer Forschung und Technologie, Bonn (Germany). [1992] 18p. (In German). Contract BMFT 13N5689. Order Number DE93750348. Source: OSTI; NTIS (US Sales Only); INIS.

In the context of the experiment on 'Development of high temperature superconducting system components' supported by the German Ministry of Research and Technology, investigations were carried out by the Working Party of Prof. von Schnering at the Max Planck Institute for Solids Research, the aim of which is to find characteristic structural features of superconducting substances. Alternative systems are to be looked for with the aid of correlation of superconducting properties with simple electronic and chemical structure models, where very powerful 3D computer graphics are used to visualize them. The theoretical and information technology part of the work was supplemented by experiments. Superconducting phases and related compounds were represented and their structures and physical properties were determined. According to the tasks described above, the report is divided into three sections. Starting with the description of a program system for three-dimensional representation of structures and properties of periodic systems, in the second section a process for calculating node surfaces is explained and the importance of curvature in chemical structures is pointed out. The results of the experiments are collected in the third part. (orig.).

7143 (LBL–32891) **Bicrystal YBCO dc squids with low noise.** Miklich, A.H.; Koelle, D.; Dantsker, E.; Nemeth, D.T.; Kingston, J.J.; Kromann, R.F.; Clarke, J. Lawrence Berkeley Lab., CA (United States). Aug 1992. 4p. Sponsored by USDOE, Washington, DC (United States); California Competitive Technology Program, CA (United States); Deutsche Forschungsgemeinschaft, Bonn (Germany); Fannie and John Hertz Foundation (United States). DOE Contract AC03-76SF00098. (CONF-920802–45: Applied superconductivity conference, Chicago, IL (United States), 23-28 Aug 1992). Order Number DE93004779. Source: OSTI; NTIS; GPO Dep.

We have fabricated 12 dc SQUIDs by laser depositing $YBa_2Cu_3O_{7-x}$ on a $SrTiO_3$ bicrystal substrate with a misorientation angle of 24°. At 77K all twelve devices had acceptable values of critical current, resistance and voltage modulation produced by an external magnetic field. The white noise energy of one device with an estimated inductance of 41 pH was 1.8×10^{-30} JHz^{-1}. The noise power scaled as 1/f at frequencies below about 1kHz, however, by using a bias current reversal scheme we were able to reduce this noise by two orders of magnitude at 1 Hz, to a value of about 1.5×10^{-29} JHz^{-1}. We made a magnetometer by coupling the SQUID to a flux transformer with a 5-turn input coil. The measured magnetic field gain was 60, and the white noise 36fT $Hz^{\frac{-1}{2}}$. However, the transformer produced relatively large levels of 1/f flux noise, not reduced by the bias reversal scheme, that limited the noise at 1 Hz to 1.7 pT $Hz^{\frac{-1}{2}}$. A single-layer magnetometer with a single-turn pick up loop is briefly described.

7144 (LBL–32979) **Reduced mass persistent switches for large superconducting magnets in space.** Green, M.A. Lawrence Berkeley Lab., CA (United States). Aug 1992. 4p. Sponsored by USDOE, Washington, DC (United States); National Aeronautics and Space Administration, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-920802–44: Applied superconductivity conference, Chicago, IL (United States), 23-28 Aug 1992). Order Number DE93004782. Source: OSTI; NTIS; GPO Dep.

Superconducting magnets in space must operate in the persistent mode. This paper describes the characteristics of low mass niobium titanium persistent switches for low mass superconducting magnets which are designed to quench protect themselves through the quench back process. (The whole coil is driven normal shortly after the quench has started and the magnet stored energy is taken up by the coil and the persistent switch.) The concept Of using a resistor and diode in parallel with the persistent switch to reduce the overall mass of the persistent switch system and the helium consumption during magnet charging is discussed in the report. A 1.4 meter diameter free-flyer version of the 11.6 Mi stored energy ASTROMAG magnet and its persistent switch is presented as an example.

7145 (UCRL–53943-91, pp. 102-104) **Fermi-surface measurements and planar orthorhombic order in $La_{2-x}Sr_xCuO_4$.** Sterne, P.A. (Lawrence Livermore National Lab., CA (United States)); Howell, R.H.; Solal, F.R.; Fluss, M.J.; Kaiser, J.H.; West, R.N.; Kojima, H.; Kitazawa, K. Lawrence Livermore National Lab., CA (United States). [1991]. In *Chemistry and Materials Science,*

1990–1991. [Second annual report]. 241p. Order Number DE93001761. Source: OSTI; NTIS.

The authors have made new, highly precise measurements of the room-temperature electron-positron momentum spectra of $La_{1.87}Sr_{0.13}CuO_4$ and corresponding calculations based on the local-density approximation. The data show sharp features indicative of a Fermi surface, in remarkable agreement with calculations of the copper-oxygen plane bands. Strong planar orthorhombicity is revealed in the electronic structure above the tetragonal-orthorhombic transition temperature.

665420 Superfluidity

Refer also to citation(s) 6819, 6825

7146 (ETDE/JP-mf–93753763, pp. 168-189) **Application of superfluid helium cooling to space.** Murakami, M. (University of Tsukuba, Tsukuba (Japan)). Cryogenic Association of Japan, Tokyo (Japan). [1991]. 606p. (In Japanese). In *Proceedings of the 1st-4th cryogenic engineering summer seminar (1988-1991).* Order Number DE93753763. Source: OSTI; NTIS (US Sales Only).

The present report generally explained the superfluid helium (HeII) and space use cryogenic mission. As thermal fluid characteristics, the HeII is a mixed system of both viscid (normal fluid component) and inviscid (superfluid component) fluid, and the latter is null in entropy. The HeII excels the HeI and supercritical helium as a space use cryogenic refrigerant in the following points: Higher in density than the HeI. Lower in temperature than the HeI and supercritical helium. Its thermomechanical effect is utilizable. The temperature can be actually made uniform by a thin film flow. Differently from the supercritical helium, the remaining quantity can be made to nil in the tank at the finish of missioning. The utilization mainly aims at the cryogenic cooling because of lowering in thermal background noise, heightening in sensitivity of detector and cooling in superconducting magnet. The space use mission covers the global observation utilizing the infrared ray as well as infrared astronomical observation, X-ray astronomical observation and cosmic high energy corpuscular ray observation utilizing the superconducting magnet. 12 refs., 16 figs., 5 tabs.

7147 (KFTI–90-5) **Variational principle and flows of additive motion integrals in superfluid systems.** Peletminskij, S.V.; Tarasov, A.N.; Shishkin, A.L. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. [10] (In Russian). Order Number DE93610443. Source: OSTI; NTIS (US Sales Only); INIS.

Using variational principle and Bogolyubov method expressions for equilibrium densities of energy for equilibrium densities of energy flows, impulse, particle number in normal and superfluid systems are obtained. 9 figs.

6655 Direct Energy Conversion

Refer also to citation(s) 6839

70 PLASMA PHYSICS AND FUSION

Refer also to citation(s) 5730

7003 Plasma Physics and Fusion Research

Refer also to citation(s) 6267, 6338, 7103, 7372, 7377, 7381

7148 (CONF-8909210–, pp. 211-220) **Screening effects in nuclear fusion of hydrogen isotopes in dense media.** Arista, N. (Centro Atomico Bariloche (Argentina)); Baragiola, R.; Gras-Marti, A. Oak Ridge National Lab., TN (United States). Apr 1990. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

Nuclear fusion rates of isotopic hydrogen nuclei embedded in dense screening media are calculated. The authors consider the cases of a uniform degenerate electron gas and the inhomogeneous electron density in solids. They derive an exact wave function for the screened nuclear interaction, and an analytical expression for the barrier-penetration factor, in the case of homogeneous screening. For qualitative estimates of the screening in solids, they use a Thomas-Fermi description of the electron density. A cross-over of the fusion rates of the various isotopic pairs analyzed (p-d, d-d, p-t and d-t) is predicted for increasing screening length, velocity or effective temperature of the medium. The effects of variables screening length and local effective temperatures are considered for electron gases in the range of metallic densities and compared with previous experimental and theoretical studies.

7149 (CONF-8909210–, pp. 507-516) **Independent-particle model for fusion in cluster impact.** Crawford, O.H. (Oak Ridge National Lab., TN (United States)). Oak Ridge National Lab., TN (United States). Apr 1990. DOE Contract AC05-84OR21400. From 12. Werner Brandt international workshop on charged particle penetration phenomena; San Sebastian (Spain); 4-7 Sep 1989. In *The 12th Werner Brandt international conference on the penetration of charged particles in matter.* 680p. Order Number DE90012031. Source: OSTI; NTIS; INIS.

Theory is presented in an independent-particle model for the fusion yields from impact of accelerated $(D_2O)_n^+$ clusters on TiD. It is assumed that deuterons from an incident cluster penetrate the medium independently of each other. Comparison is made with the recent experiment of Beuhler, Friedlander, and Friedman. The measured fusion yields, for n values ranging from 22 to 1,300, are many orders of magnitude higher than those calculated from this theory. This implies that the mechanism depends crucially on cumulative or cooperative effects involving many cluster atoms.

7150 (CONF-920913–3) **Dimensionless scaling of confinement in ATF.** Murakami, M.; Bigelow, T.S.; Wilgen, J.B.; Dory, R.A.; Carreras, B.A.; Batchelor, D.B.; Baylor, L.R.; Bell, G.L.; Bell, J.D.; Colchin, R.J.; Crume, E.C.; Dominguez, N.; Dunlap, J.L.; Dyer, G.R.; England, A.C.; Glowienka, J.C.; Goldfinger, R.C.; Goulding, ROak Ridge National Lab., TN (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 14. international conference on plasma physics and controlled nuclear fusion research; Wuerzburg (Germany); 30 Sep - 7 oct 1992. Order Number DE93001705. Source: OSTI; NTIS; INIS; GPO Dep.

The results of dimensionless-parameter modulation and configuration control experiments in the Advanced Toroidal Facility (ATF) are presented. The global energy confinement time fits gyro-Bohm scaling better than Bohm-like scaling. An additional dependence was detected by modulation of single dimensionless parameters (collisionality ν^* and beta β), yielding $\tau_E/\tau_{gB} \propto \nu^{*\ \alpha\nu} \beta^{\alpha\beta}$, where $\alpha_\nu = 0.\ 1\ 8 \pm 0.03$ and $\alpha_\beta = 0.3 \pm 0.\ 1$. Application of this formula to NBI and ECH data significantly improves the fit, implying that improved confinement will result from increasing the heating power. Little change in confinement occurred for wide variations in the confined trapped particle fraction at constant magnetic well radius and shear. This may be explained by reduction of the helically trapped panicle loss region due to the radial electric field. Configuration modulation experiments showed that the energy confinement time improves as the magnetic well radius expands, the result expected from some stabilization of resistive interchange instabilities. This is consistent with fluctuation measurements and may explain the positive dependence of confinement on β.

7151 (CONF-920913–19) **Self-regulated shear flow turbulence in confined plasmas: Basic concepts and potential applications to the L → H transition.** Diamond, P.H. (California Univ., San Diego, La Jolla, CA (United States)); Shapiro, V.; Schevchenko, V.; Kim, Y.B.; Rosenbluth, M.N.; Carreras, B.A.; Sidikman, K.; Lynch, V.E.; Garcia, L.; Terry, P.W.; Sagdeev, R.Z. Oak Ridge National Lab., TN (United States). [1992]. 48p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. (IAEA-CN–56/D-2-4). From 14. international conference on plasma physics and controlled nuclear fusion research; Wuerzburg (Germany); 30 Sep - 7 oct 1992. Order Number DE93002361. Source: OSTI; NTIS; INIS; GPO Dep.

This paper describes developments in the theory of edge plasma turbulence in a differentially rotating plasma. The thesis that such systems are dynamically self-regulating is presented. Results indicate that relevant fluctuations will generate a predominantly curved

flow. Similar, curvature is shown to be the predominant flow profile effect on fluctuations. A system fixed point is identified, the eigenfrequencies for small oscillations around it are calculated, and an over-all stability criterion is determined.

7152 (CONF-920913–24) **Alpha effects on TAE modes and alpha transport.** Cheng, C.Z. (Princeton Univ., NJ (United States). Plasma Physics Lab.); Fu, G.Y.; Mynick, H.E.; Budny, R.; White, R.B.; Zweben, S.J.; Hsu, C.T.; Sigmar, D.J.; Spong, D.A.; Carreras, B.A.; Hedrick, C.L. Oak Ridge National Lab., TN (United States). [1992]. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400 ;AC02-76CH03073 ;AC02-78ET51013. (IAEA-CN–56/D-2-1(C)). From 14. international conference on plasma physics and controlled nuclear fusion research; Wuerzburg (Germany); 30 Sep - 7 oct 1992. Order Number DE93004160. Source: OSTI; NTIS; INIS; GPO Dep.

In a fusion reactor any unanticipated loss of alpha power could result in serious wall damage, impurity influx, major operational control problems, and even a failure to sustain ignition. Neutral beam injection (NBI) experiments in large tokamaks have indicated that toroidicity-induced Alfven eigenmode (TAE) can be strongly unstable and cause the loss of about half of the fast beam ions. This level of loss would be unacceptable in fusion reactors. Recent experiments in TFTR indicate that TAE modes can also be excited by energetic particles heated by ICRF. Stability of TAE modes in the presence of alpha particles had previously been studied by employing a global kinetic-MHD stability code (NOVA-K). The alpha transport due to a single toroidal mode number TAE mode had also been studied by using a Hamiltonian guiding center orbit code, ORBIT. In Section 1 we present the properties of the TAE mode, the effects of alpha particles on TAE instabilities for TFTR D-T and ITER experiments. The alpha transport due to multiple toroidal mode number TAE modes and a stochastic transport theory are presented.

7153 (CONF-9211140–1-Vugraphs) **High beta effects and nonlinear evolution of the TAE instability.** Spong, D.A. Oak Ridge National Lab., TN (United States). [1992]. 37p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From United States/Japan workshop on theory of high beta plasmas; San Diego, CA (United States); 11-13 Nov 1992. Order Number DE93004170. Source: OSTI; NTIS; INIS; GPO Dep.

The toroidal Alfven eigenmode has recently been observed experimentally on DIII-D and TFTR when neutral beams are injected near the Alfven velocity. This instability is also of concern for future high β D-T devices where fusion by-product alpha populations will generally be super-Alfvenic. We have developed a gyrofluid model (with Landau closure) of the TAE mode which can include most of the relevant damping mechanisms (continuum damping, ion and electron damping, ion FLR and collisional trapped electron damping) as well as reproducing analytically predicted undamped growth rates relatively accurately. An important consideration in predicting future unstable TAE regimes is the effect of finite beta in the background plasma. Due to the Shafranov shift and distortion of the flux surfaces, the location of the stable TAE root and the continuum will shift with increasing β. The net effect of this is to generally enhance continuum damping and stabilize the TAF instability. Also, as the pressure gradient drive from the background becomes increasingly important, coupling between TAE and background driven modes can alter the TAE mode. A further application of our gyrofluid model which will be discussed is the nonlinear evolution of the TAE instability. Gyrofluid models offer a convenient reduced description which is more amenable to computational nonlinear modeling than full kinetic particle models. Our results demonstrate the rise and crash phases of TAE activity similar to experimental observations. The saturation is caused by generation of m=0 n=0 components through nonlinear beatings of the $n > 1$ modes; these cause modifications to the original equilibrium profiles in such a direction as to decrease the instability drive. This is the gyrofluid analog of direct particle losses. The peak magnetic fluctuation level increases with increasing energetic species beta, resulting in nonresonant stochastization of magnetic field lines.

7154 (DOE/ER/12105–2) **Investigation of cold nuclear fusion in condensed matter: Final report.** Jones, S.E. (Brigham Young Univ., Provo, UT (United States)); Berrondo, M.; Czirr, J.B.; Decker, D.L.; Harrison, K.; Jensen, G.L.; Palmer, E.P.; Rees, L.B.; Shelton, D.S.; Taylor, S.; Vanfleet, H.B.; Wang, J.C.; Bennion, D.N.; Harb, J.N.; Pitt, W.G.; ThornBrigham Young Univ., Provo, UT (United States). 29 Dec 1992. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER12105. Order Number DE93006083. Source: OSTI; NTIS; INIS; GPO Dep.

Recent research has been directed towards finding means to produce neutron emissions at will, to demonstrate reproducibility, and to permit in-depth studies of the origin of neutron emissions. this goal has been pursued in the Kamiokande detector in Japan and has led to the development of a deep underground laboratory in a tunnel in the Wasatch mountains near Brigham Young University. New counters for low-level neutron emissions are being utilized. Calorimetric tools have also been developed.

7155 (DOE/ER/12114–2) **Experimental, theoretical and computational study of frequency upshift of electromagnetic radiation using plasma techniques: Annual technical report, January 15, 1992–January 14, 1993.** Joshi, C. California Univ., Los Angeles, CA (United States). School of Engineering and Applied Science. Sep 1992. 32p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-91ER12114. Order Number DE93005092. Source: OSTI; NTIS; GPO Dep.

This is a second year progress report on "Experimental, Theoretical and Computational Study of Frequency Upshift of Electromagnetic Radiation Using Plasma Techniques." The highlights are: (I) Ionization fronts have been shown to frequency upshift e.m. radiation by greater than a factor 5. In the experiments, 33 GHz microwave radiation is upshifted to more than 175 GHz using a relativistically propagating ionization front created by a laser beam. (II) A Letter describing the results has been published in Physical Review Letters and an "invited" paper has been submitted to IEEE Trans. in Plasma Science.

7156 (DOE/ER/52130–T3) **UCLA program in theory and modeling of edge physics and plasma material interaction: Progress report, June 1991–June 1992.** Conn, R.W.; Najmabadi, F.; Grossman, A.; Merriman, B.; Day, M. California Univ., Los Angeles, CA (United States). [1992]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-86ER52130. Order Number DE93006068. Source: OSTI; NTIS; INIS; GPO Dep.

Our research activity in edge plasma modeling is directed towards understanding edge plasma behavior and towards innovative solutions for controlling the edge plasma as well as the design and operation of impurity control, particle exhaust. and plasma facing components. During the last nine months, substantial progress was made in many areas. The highlights are: (A) Development of a second-generation edge-plasma simulation code (Section II); (B) Development of models for gas-target divertors, including a $1\frac{1}{2}$-D fluid model for plasma and Monte Carlo neutral-transport simulations (Section III); and (C) Utilization of the RF ponderomotive force and electrostatic biasing to distribute the heat load on a larger area of the divertor plate, and the development of analytical and numerical transport models that include both ponderomotive and electrostatic potentials.

7157 (DOE/ER/52134–T2) **PISCES Program: Plasma-materials interactions and edge-plasma physics research: Progress report, 1991–1992.** Conn, R.W.; Hirooka, Y. California Univ., Los Angeles, CA (United States). Jul 1992. 64p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-86ER52134. Order Number DE93005089. Source: OSTI; NTIS; INIS; GPO Dep.

This program investigates and characterizes the behavior of materials under plasma bombordment, in divertor regions. The PISCES facility is used to study divertor and plasma edge management concepts (in particular gas target divertors), as well as edge plasma turbulence and transport. The plasma source consists of a hot LaB_6 cathode with an annular, water-cooled anode and attached drift tube. This cross sectional area of the plasma can be adjusted between 3 and 10 cm. A fast scanning diagnostic probe system was used for mapping plasma density profiles during biased limiter and divertor simulation experiments. Some experimental data are given on: (1) materials and surface physics, (2)

edge plasma physics, and (3) a theoretical analysis of edge plasma modelling.

7158 (DOE/ER/53216–13) **The University of Wisconsin-Madison Torsatron/Stellarator Laboratory program: Progress summary report.** Wisconsin Univ., Madison, WI (United States). Oct 1992. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-86ER53216. Order Number DE93005922. Source: OSTI; NTIS; INIS; GPO Dep.

A summary of results obtained during the past year of the current grant for research at the University of Wisconsin-Madison Torsatron/Stellarator Laboratory is presented along with goals for the next funding period. Research efforts have focussed on fundamental physics issues associated with toroidal confinement, predominantly through experimental investigations on the Interchangeable Module Stellarator (IMS), in the topics of fluctuations, potentials and electric fields, and plasma rotation and damping. Theoretical and computational activities have also been undertaken to support the experimental research and to identify interesting new toroidal confinement concepts which could contribute to the understanding of tokamak transport. Accomplishments during this grant period are described.

7159 (DOE/ER/53218–21) **Fusion Plasma Theory: Task 3, Auxiliary radiofrequency heating of tokamaks: Annual report, November 16, 1991–November 15, 1992.** Scharer, J.E. Wisconsin Univ., Madison, WI (United States). Dept. of Electrical and Computer Engineering. [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-86ER53218. Order Number DE93005129. Source: OSTI; NTIS; INIS; GPO Dep.

The research performed under this grant during the past year has been concentrated on the following several key tokamak ICRF (Ion Cyclotron Range of Frequencies) coupling, heating and current drive issues: Efficient coupling during the L- to H- mode transition by analysis and computer simulation of ICRF antennas; analysis of ICRF cavity-backed coil antenna coupling to plasma edge profiles including fast and ion Bernstein wave coupling for heating and current drive; benchmarking the codes to compare with current JET, D-IIID and ASDEX experimental results and predictions for advanced tokamaks such as BPX and SSAT (Steady-State Advanced Tokamak); ICRF full-wave field solutions, power conservation, heating analyses and minority ion current drive; and the effects of fusion alpha particle or ion tail populations on the ICRF absorption. Research progress, publications, and conference and workshop presentations are summarized in this report.

7160 (DOE/ER/54071–T3) **Salient issues of edge physics pertaining to loss of confinement: A resistive MHD analysis: Final report.** Thayer, D.R. Science Applications International Corp., San Diego, CA (United States). 23 Apr 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-90ER54071. Order Number DE93006123. Source: OSTI; NTIS; INIS; GPO Dep.

Contributions were made towards the ultimate goal of creating a complete theory of edge turbulence and transport in magnetic fusion devices. The main focus has been to utilize a resistive MHD model. This analysis includes: (1) "rippling" type models in which the current fluctuations are decoupled and the resistivity fluctuations are fundamental, and (2) "drift" type models in which the ambient current can be small (no resistivity fluctuations needed) and the current fluctuations are fundamental. In these turbulence frameworks, the important atomic physics based edge sources have been included (impurity radiation, ionization, and charge exchange effects).

7161 (DOE/ER/54071–T4) **Salient issues of edge physics pertaining to loss of confinement: A resistive MHD analysis: Technical progress report, FY91.** Thayer, D.R. Science Applications International Corp., San Diego, CA (United States). [1991]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-90ER54071. Order Number DE93006124. Source: OSTI; NTIS; INIS; GPO Dep.

The progress that has been made during this fiscal year is significant in the area of tokamak edge plasma transport. Important contributions on the extension of the drift-rippling mode model ($\sim \tau$, $\sim n$, $\sim T$, $\sim \nu_{\parallel}$) of edge turbulent transport. In particular, the research areas on which we have concentrated include the following topics: (1) The theoretical investigation of the radiatively enhanced transport due to the effects of impurity driven radiation instabilities has been expanded to include a situation with multiple impurities (such as carbon, C^{4+}, and oxygen, O^{6+}); (2) In order to validate the use of the impurity radiation input from the tokamak bolometer experiments in our theoretical edge turbulent transport calculations, the analysis that is utilized to transform impurity brightness data to radiated power profiles has been checked for state population and Abel inversion correctness; (3) The drift-rippling model of edge turbulent transport has been extended to include ionization particle sources in addition to the impurity driven thermal instability drive; and (4) The detailed limiter and realistic edge geometric effects on the edge turbulent transport has been included in the drift-rippling model.

7162 (DOE/ER/54071–T5) **Thermally driven turbulence and transport in a sheared system.** Thayer, D.R. (Science Applications International Corp., San Diego, CA (United States)); Diamond, P.H. Science Applications International Corp., San Diego, CA (United States). [1992]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-90ER54071 ;FG03-88ER53275. Order Number DE93006125. Source: OSTI; NTIS; INIS; GPO Dep.

Results from a novel theory of radiatively enhanced tokamak edge turbulent transport are presented. A serious restriction on the impurity radiation drive is identified. In particular, due to a lack of pressure balance near a rational surface, the condensation effect does not survive. Consequently, the thermal instability drive is the only impurity radiation instability which remains. Our analysis consists of a theoretical calculation for the thermally driven drift-rippling mode model ($\tilde{\theta}$, $\tilde{n}$, $\tilde{T}$, $\tilde{\nu}_{\parallel}$). We present calculations of the edge fluctuations and the resultant transport coefficients versus radius.

7163 (DOE/ER/54139–1) **TFTR experimental data analysis collaboration: Annual progress report, November 15, 1991–November 14, 1992.** Callen, J.D. Wisconsin Univ., Madison, WI (United States). Dept. of Nuclear Engineering and Engineering Physics. Jun 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-92ER54139. Order Number DE93002365. Source: OSTI; NTIS; INIS; GPO Dep.

The research performed under the initial year of this grant has concentrated on a few key TFTR experimental data analysis issues: MHD effects on supershots; poloidal asymmetry effects in beam-heated plasmas; and analysis of transport processes in perturbed plasmas. Progress in these areas and activities undertaken in conjunction with this grant are summarized briefly in this report.

7164 (DOE/ET/53088–578) **Kinetic theory of toroidicity and ellipticity-induced Alfven eigenmodes.** Mett, R.R.; Mahajan, S.M. Texas Univ., Austin, TX (United States). Inst. for Fusion Studies. Oct 1992. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-80ET53088. (IFSR–578;CONF-920813–2: Joint Varenna-Lausanne international workshop on theory of fusion plasmas, Varenna (Italy), 24-28 Aug 1992). Order Number DE93003634. Source: OSTI; NTIS; INIS; GPO Dep.

Toroidicity-induced Alfven eigenmodes (TAE) and ellipticity-induced Alfven eigenmodes (EAE) are currently of great interest because they may destroy the confinement of fast ions in a burning tokamak plasma. The present study focuses on kinetic effects, extending the non-perturbative kinetic analysis of the TAE to the EAE. One finds that the parameter which measures the kinetic character of the EAE is significantly smaller than it is for the TAE for elongated plasmas like DIII-D. The parameter is rather small for the lower mode numbers but attains values of order unity or larger for the higher mode numbers, since the parameter scales as the square of the mode number. Consequently, one expects the lower mode number EAE's to have a strongly magnetohydrodynamic (MHD) character, and to suffer only perturbative damping that depends linearly on the dissipative mechanisms. However, while the former is true, the latter is not necessarily the case. This work examines these kinetic T/EAE(KT/EAE) modes in further detail.

7165 (DOE/ET–53088-583) **Effect of alpha particles on Toroidal Alfven Eigenmodes.** Berk, H.L. Texas Univ., Austin, TX

(United States). Inst. for Fusion Studies. Nov 1992. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-80ET53088. (IFSR–583). Order Number DE93003635. Source: OSTI; NTIS; INIS; GPO Dep.

An overview is given of the analytic structure for the linear theory of the Toroidal Alfven Eigenmode (TAE), where multiple gap structures occur. A discussion is given of the alpha particle drive and the various dissipation mechanisms that can stabilize the system. A self-consistent calculation of the TAE mode, for a low-beta high-aspect-ratio plasma, indicates that though the alpha particle drive is comparable to the dissipation mechanisms, overall stability is still achieved for ignited ITER-like plasma. A brief discussion is given of the nonlinear theory for the TAE mode and how nonlinear alpha particle dynamics can be treated by mapping methods.

7166 (ETDE/JP-mf–93753763, pp. 306-321) **Practical application of superconducting magnet.: Nuclear fusion reactor use magnet.** Tsuji, H. (Japan Atomic Energy Research Institute, Tokyo (Japan)). Cryogenic Association of Japan, Tokyo (Japan). [1991]. 606p. (In Japanese). In *Proceedings of the 1st-4th cryogenic engineering summer seminar (1988-1991).* Order Number DE93753763. Source: OSTI; NTIS (US Sales Only).

The present report explained the development status of nuclear fusion reactor use large superconducting magnet. In the nuclear fusion reaction, the conversion into helium and neutron upon the fusion of deuterium and tritium generates energy corresponding to the decrease in mass. Approach to within the range where the internucleon force works beyond the Coulomb barrier is made by confining superhigh temperature plasma, higher than 10^8 centigrade. The confinement to the magnetic field utilizes the electromagnetically mutual action of plasma and magnetic field. The consumed power surpasses the generated energy in the normally used coil, which is therefore not put to practical use. The superconducting coil can be used only with a little power to operate the refrigerator. In order to control the tokamak type plasma, Japan Atomic Energy Research Institute developed a poloidal coil which can give a pulsation. Able to strengthen the magnetic field up to 7T in 1sec quickly and steeply as well as stably, that coil achieved a pulsation for the worldwidely first time as a large superconducting coil which uses Nb_3Sn. The enforced refrigeration system and lowering in thermal loss at the time of pulsation could prevent the temperature from heightening and the coil from being broken by the superconduction. 3 refs., 17 figs., 4 tabs.

7167 (GA-A–20978) **The CQL3D Fokker-Planck code.** Harvey, R.W. (General Atomics, San Diego, CA (United States)); McCoy, M.G. General Atomics, San Diego, CA (United States). Nov 1992. 38p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-89ER53277 ;W-7405-ENG-48. (CONF-9206235–3: International Atomic Energy Agency (IAEA) technical committee meeting on advances in simulation and modeling of thermonuclear plasmas, Montreal (Canada), 15 Jun 1992). Order Number DE93002962. Source: OSTI; NTIS; INIS; GPO Dep.

CQL3D is a general purpose computer code for modeling auxiliary heating in tokamaks. It calculates the radial distribution of 2D in momentum-space bounce-averaged, ion and electron distribution functions in toroidal geometry, consistent with deposition of rf and/or neutral beam injected power and a diffusive radial transport model. This calculation is carried out with an array of bounce-averaged Fokker-Planck (FP) solvers running on noncircular magnetic flux surfaces, giving the steady-state, toroidally-averaged distribution resulting from a balance between collisions, dc electric field, rf quasilinear diffusion, synchrotron radiation, neutral beam injection, and radial diffusion. CQL3D is coupled to ray-tracing codes for electron cyclotron, lower hybrid, and fast waves, to a neutral beam deposition code, and to a noncircular equilibrium code. We describe the code, providing expressions and methodology for calculation of the FP coefficients from each of the constituent processes, and give benchmark applications in order to validate the major components of the code.

7168 (GA-A–21053) **Regimes of improved confinement and stability in DIII-D obtained through current profile modifications.** Lao, L.L. (General Atomics, San Diego, CA (United States)); Ferron, J.R.; Taylor, T.S.; Chan, V.S.; Osborne, T.H.; Burrell, K.H.; Chu, M.S.; DeBoo, J.C.; Greenfield, C.M.; Groebner, R.J.; Jackson, G.L.; St. John, H.; Strait, E.J.; Thompson, S.J.; Turnbull,General Atomics, San Diego, CA (United States). Sep 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-89ER51114 ;AC05-84OR21400 ;W-7405-ENG-48. (CONF-920913–21: 14. international conference on plasma physics and controlled nuclear fusion research, Wuerzburg (Germany), 30 Sep - 7 oct 1992). Order Number DE93002674. Source: OSTI; NTIS; INIS; GPO Dep.

Several regimes of improved confinement and stability have been obtained in recent experiments in the DIII-D tokamak by dynamically varying the toroidal current density profile to transiently produce a poloidal magnetic field profile with more favorable confinement and stability properties. A very peaked current density profile with high plasma internal inductance, ℓ_i, is produced either by a rapid change in the plasma poloidal cross section or by a rapid change in the total plasma current. Values of thermal energy confinement times nearly 1.8 times the JET/DIII-D ELM-free H-mode thermal confinement scaling are obtained. The confinement enhancement factor over the ITER89-P L-mode confinement scaling, H, is as high as 3. Normalized toroidal beta, β_N, greater than 6%-m-T/MA and values of the product $\beta_N H$ greater than 15 have also been obtained. Both the confinement and the maximum achievable β vary with ℓ_i and decrease as the current profile relaxes. For strongly shaped H-mode discharges, in addition to the current density profile peakedness, as measured by ℓ_i other current profile parameters, such as its distribution near the edge region, may also affect the confinement enhancement.

7169 (GA-A–21055) **Profile characteristics of H-mode bifurcation models and turbulence simulations with Gyro-Landau Fluid models in slab and toroidal geometry.** Staebler, G.M. (General Atomics, San Diego, CA (United States)); Waltz, R.E.; Dominguez, R.R.; Greenfield, C.M.; Hinton, F.L.; Beer, M.; Dorland, W.; Hammett, G.W.; Kerbel, G.D.; Kurki-Suonio, T.K.; Wiley, J.C. General Atomics, San Diego, CA (United States). Sep 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-89ER51114 ;AC03-89ER53277 ;W-7405-ENG-48 ;AC02-76CH03073. (CONF-920913–22: 14. international conference on plasma physics and controlled nuclear fusion research, Wuerzburg (Germany), 30 Sep - 7 oct 1992; IAEA-CN–56/D-4-17). Order Number DE93002676. Source: OSTI; NTIS; INIS; GPO Dep.

A study of the sensitivity of the width of the H-mode transport barrier on the energy, particle and momentum sources has led to a possible explanation for the very high confinement (VH-mode) presented in Part A of this paper. In Part B recent progress in the development of Gyro-Landau Fluid (GLF) models n described. GLF models with a few moment equations encompass with high accuracy both linearly and nonlinearly the effects of finite gyroradius to all orders and of the Landau resonances in both parallel field and curvature drift motion. Numerical simulation of turbulence with a novel application of a nonlinear ballooning mode representation of these models is given.

7170 (GTFR–102) **Physics models and user's guide for the neutral beam module of the SUPERCODE.** Mandrekas, J. Georgia Inst. of Tech., Atlanta, GA (United States). Fusion Research Center. Aug 1992. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-91ER54122. Order Number DE93002318. Source: OSTI; NTIS; INIS; GPO Dep.

This report contains a description of the neutral beam heating and current drive module Beams, that was developed at Georgia Tech for the SUPERCODE, the new systems and operations code for the ITER EDA. The NB module calculates profiles of the neutral beam deposition, fast ion pressure, beam heating power, and neutral beam driven current density. It also computes global parameters such as current drive efficiencies, beam shinethrough, fast beam ion beta, and the fusion power and neutron production due to beam-plasma interactions. The most important consideration during the development of this module was to make it compute normally fast without compromising physical accuracy. We believe that through careful selection of physical models and optimized coding, these conflicting requirements have been largely met. As a result, the SUPERCODE has now the ability to perform self-consistent calculations involving NB heating and current drive. This capability is very important for the study of sub-ignited, hybrid, or

steady-state ITER and post-TFIR reactor operating scenarios. It is also the first time that a systems code has had such capabilities, usually found only in 1-1/2D plasma transport codes.

7171 (GTFR–103) **Poloidal rotation, density asymmetries and momentum confinement in tokamak experiments.** Stacey, W.M.; Jackson, D.R. Georgia Inst. of Tech., Atlanta, GA (United States). Fusion Research Center. Aug 1992. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-87ER51112. Order Number DE93002319. Source: OSTI; NTIS; INIS; GPO Dep.

Poloidal rotation speeds and density asymmetries are calculated for the deuterium and dominant carbon (oxygen) impurity ions in discharges in ASDEX, DIII, ISX-B, JET, and TFTR for which $v_\phi \sim v_{th}$ for the ions. These poloidal rotation speeds and density asymmetries are used to evaluate the neoclassical gyroviscous model for the momentum confinement time. The rather good agreement with experimental momentum confinement times obtained over this wide range of plasma parameters provides a measure of confidence in the calculated density asymmetries and poloidal rotation, as well as arguing for a neoclassical explanation for momentum confinement in tokamaks.

7172 (IFPiLM–2/90) **Studies of anomalous phenomena in Nd and CO_2 lasers produced plasma at average reduced power densities: $10^{12}Wcm^{-2}\mu m^2 < I_L\lambda_L^2 < 10^{14}Wcm^{-2}\mu m^2$.** Wolowski, J. Wojskowa Akademia Techniczna, Warsaw (Poland). Inst. Fizyki Plazmy i Laserowej Mikrosyntezy. 1990. [211] (In Polish). Order Number DE93610249. Source: OSTI; NTIS (US Sales Only); INIS.

The methodics and instrumentation use for plasma diagnostics are described. The results of carried out experiments are presented and discussed taking into account classical models of laser-produced plasma. Phenomenological analysis, quantitative assessments and the synthetic description of collisional processes and anomalous phenomena in studied plasma are given. 273 refs. (A.S.).

7173 (INIS-mf–13204, pp. 7-10) **Control of plasma column horizontal position in TBR-1.** Tuszel, A.G. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica); Rincoski, C.R.M. Comision Nacional de Energia Atomica, Buenos Aires (Argentina); International Atomic Energy Agency, Vienna (Austria); Secretaria de Ciencia y Tecnica, Buenos Aires (Argentina). 1990. [368] (CONF-900739–: 4. Latin American workshop on plasma physics, Buenos Aires (Argentina), 16-27 Jul 1990). In *Fourth Latin-American workshop on Plasma Physics (held in) Buenos Aires, Argentina, 16-27 Jul 1990. Contributed papers.* Order Number DE92635466. Source: OSTI; NTIS (US Sales Only); INIS.

The TBR-1 is a small tokamak built at the Physics Institute of the University of Sao Paulo. It was originally designed with a simple vertical field power supply made of one fast capacitor bank for vertical current build-up and one slow capacitor bank for flat-top phase, without any control but the adjustable initial voltages of the capacitors. With such an elementary system, the plasma cannot be held in the center of the vacuum vessel for the whole duration of the plasma. This led to a suboptimal performance with easy disruptions. A control system was designed to hold the plasma centered in the radial coordinate. (Author).

7174 (INIS-mf–13204, pp. 3-6) **Particle and energy transport in the plasma edge of TBR-1 Tokamak.** Silva, R.P. da (Sao Paulo Univ., SP (Brazil). Inst. de Fisica); Nascimento, I.C.; Fagundes, A.N.; Sanada, E.K.; Castro, R.M. de. Comision Nacional de Energia Atomica, Buenos Aires (Argentina); International Atomic Energy Agency, Vienna (Austria); Secretaria de Ciencia y Tecnica, Buenos Aires (Argentina). 1990. [368] (CONF-900739–: 4. Latin American workshop on plasma physics, Buenos Aires (Argentina), 16-27 Jul 1990). In *Fourth Latin-American workshop on Plasma Physics (held in) Buenos Aires, Argentina, 16-27 Jul, 1990. Contributed papers.* Order Number DE92635466. Source: OSTI; NTIS (US Sales Only); INIS.

This work describes measurements in the shadow region of TBR-1 limiter. TBR-1 is a small tokamak in operation at the Physics Institute of the University of Sao Paulo. Its main parameters are: R(Major Radius) = 0.30 m; a_v(Vessel Radius) = 0.11 m; a(Limiter Radius) = 0.08 m; R/a(Aspect Ratio) = 3.75; B_ϕ(Toroidal Field) = 5kG; n_{e0}(Central Electron Density) $\simeq$ 7 x $10^{18}m^3$; T_{e0}(Central Electron Temperature)$\simeq$200 eV. Two electrostatic probes were used: a Langmuir probe and an electrostatic ion probe. With the Langmuir probe temporal and radial profiles of electron temperature, plasma density and plasma potential were obtained. With the electrostatic ion probe, associated to a specially developed electronic circuit, measurements of ion and electron temperature were simultaneously obtained. (Author).

7175 (INIS-mf–13204, pp. 11-14) **Influence of the helical resonant fields on the plasma potential in the TBR-1 Tokamak.** Ribeiro, C. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica); Silva, R.P. da; Caldas, I.L.; Fagundes, A.N.; Sanada, E.K. Comision Nacional de Energia Atomica, Buenos Aires (Argentina); International Atomic Energy Agency, Vienna (Austria); Secretaria de Ciencia y Tecnica, Buenos Aires (Argentina). 1990. [368] (CONF-900739–: 4. Latin American workshop on plasma physics, Buenos Aires (Argentina), 16-27 Jul 1990). In *Fourth Latin-American workshop on Plasma Physics (held in) Buenos Aires, Argentina, 16-27 Jul 1990. Contributed papers.* Order Number DE92635466. Source: OSTI; NTIS (US Sales Only); INIS.

This work describes an experimental work that are in progress in TBR-1 tokamak about the influence of resonant helical fields on the plasma potential. TBR-1 is a small tokamak in operation in the Physics Institute of University of Sao Paulo and used for basic research, diagnostic development and personal formation. Its main parameters are: R(Major Radius) = 0.30 m; a_v(Vessel Radius) = 0.11 m; a(Plasma Radius) = 0.08 m; R/a(Aspect Ratio) = 3.75; B_ϕ(Toroidal Field) = 5 kG; n_{e0}(Central Electron Density) $\simeq$ 7 x $10^{18}m^{-3}$; T_{e0}(central electron temperature) $\simeq$ 200 eV. (Author).

7176 (INIS-mf–13204, pp. 124-127) **Interaction of waves and trapped particles.** Donoso, G. (Universidad Simon Bolivar, Caracas (Venezuela). Dept. de Fisica); Martin, P.; Puerta, J. Comision Nacional de Energia Atomica, Buenos Aires (Argentina); International Atomic Energy Agency, Vienna (Austria); Secretaria de Ciencia y Tecnica, Buenos Aires (Argentina). 1990. [368] (CONF-900739–: 4. Latin American workshop on plasma physics, Buenos Aires (Argentina), 16-27 Jul 1990). In *Fourth Latin-American workshop on Plasma Physics (held in) Buenos Aires, Argentina, 16-27 Jul 1990. Contributed papers.* Order Number DE92635466. Source: OSTI; NTIS (US Sales Only); INIS.

Different types of ion-acoustic instabilities have been studied with a DP device. Most of them are originated in ion-beam plasma systems and recently related to ion-phase vortices. Other appears as strong wave-wave interaction. When coherent waves are launched in a plasma the mechanism of chaotic behavior is also observed. Here different kind of instability is reported in which side ban waves appear and growth when a large amplitude coherent ion wave is launched in an Argon plasma produced in a DP device. (Author).

7177 (INIS-mf–13204, pp. 223-226) **Charge exchange cross-sections for multiply charged ions.** Midha, J.M. (Punjabi Univ., Patiala (India). Dept. of Physics); Gupta, S.C. Comision Nacional de Energia Atomica, Buenos Aires (Argentina); International Atomic Energy Agency, Vienna (Austria); Secretaria de Ciencia y Tecnica, Buenos Aires (Argentina). 1990. [368] (CONF-900739–: 4. Latin American workshop on plasma physics, Buenos Aires (Argentina), 16-27 Jul 1990). In *Fourth Latin-American workshop on Plasma Physics (held in) Buenos Aires, Argentina, 16-27 Jul 1990. Contributed papers.* Order Number DE92635466. Source: OSTI; NTIS (US Sales Only); INIS.

A new empirical relation for charge exchange cross-section has been proposed for different charge states of C, N and O colliding with neutral hydrogen. Results are compared with the experimental data. (Author).

7178 (INIS-mf–13204, pp. 246-249) **Double layers in a two-ion plasma.** Stella, E. (IUT Federico Rivero Palacio, Caracas (Venezuela)); Donoso, G. Comision Nacional de Energia Atomica, Buenos Aires (Argentina); International Atomic Energy Agency, Vienna (Austria); Secretaria de Ciencia y Tecnica, Buenos Aires (Argentina). 1990. [368] (CONF-900739–: 4. Latin American workshop on plasma physics, Buenos Aires (Argentina), 16-27 Jul 1990). In *Fourth Latin-American workshop on Plasma Physics*

(held in) Buenos Aires, Argentina, 16-27 Jul 1990. Contributed papers. Order Number DE92635466. Source: OSTI; NTIS (US Sales Only); INIS.

The influence of a light ion impurity on the properties of a Double Layer (DL) is studied using a fluid model for a plasma composed of two cold ion species (light and heavy) and two electron species (cold and hot) following the work of Baruthram. The fluid equations for each species including the light ions are presented. The Poisson equation and the new Sagdeev potential are calculated in the usual manner. The equations for the modified boundary conditions that lead to the existence of the Double Layer are also developed. These equations are solved numerically to obtain the Mach number, the potential amplitude and spatial width of the DL for different concentrations γ and relative mass μ of the ion impurity. A diagram of existence for the DL in the parameter space (T_h/T_c,N_h/N_c) is also presented. (Author).

7179 (INIS-mf–13204, pp. 227-230) **Impact of ion motion on induced magnetization in a laser produced plasma.** Bhattacharyya, B. (Osaka Univ., Suita (Japan). Inst. of Laser Engineering). Comision Nacional de Energia Atomica, Buenos Aires (Argentina); International Atomic Energy Agency, Vienna (Austria); Secretaria de Ciencia y Tecnica, Buenos Aires (Argentina). 1990. [368] (CONF-900739–: 4. Latin American workshop on plasma physics, Buenos Aires (Argentina), 16-27 Jul 1990). In *Fourth Latin-American workshop on Plasma Physics (held in) Buenos Aires, Argentina, 16-27 Jul 1990. Contributed papers.* Order Number DE92635466. Source: OSTI; NTIS (US Sales Only); INIS.

The electron current will dominate over ion current in an electron ion plasma and hence the electron motion can significantly affect the production of axial magnetic field in a laser produced plasma. Analytically, it has been shown that, for high frequency laser (viz. Nd-glass laser of wavelength $\lambda = 0.53$ μm and power flux $P = 10^{16}$ W/cm^2), the self generated axial magnetic due to electron motion is 10^6 times greater than that of ion in an under dense plasma. But the case would be reversed if low frequency mode can be studied in the presence of ambient magnetic field. (Author).

7180 (INIS-mf–13204, pp. 242-245) **Gyroinvariant second order drift velocities and corresponding guiding centre position: General treatment.** Martin, P. (Universidad Simon Bolivar, Caracas (Venezuela). Dept. de Fisica); Haines, M. Comision Nacional de Energia Atomica, Buenos Aires (Argentina); International Atomic Energy Agency, Vienna (Austria); Secretaria de Ciencia y Tecnica, Buenos Aires (Argentina). 1990. [368] (CONF-900739–: 4. Latin American workshop on plasma physics, Buenos Aires (Argentina), 16-27 Jul 1990). In *Fourth Latin-American workshop on Plasma Physics (held in) Buenos Aires, Argentina, 16-27 Jul 1990. Contributed papers.* Order Number DE92635466. Source: OSTI; NTIS (US Sales Only); INIS.

Gyroinvariant drift velocities have been obtained for non-uniform magnetic fields. A general treatment is presented here for non-uniform and variable electro-magnetic fields. Complex variables and non-analytical functions, combined with successive integration by parts, are introduced. There is no need to non-canonical variables in Hamiltonian or Lagrangian treatments. (Author).

7181 (INIS-mf–13204, pp. 250-253) **Stochastic phenomena and damping mechanism by the interaction of Langmuir and ion-sound wave.** Buchelnikova, N.S. (AN SSSR, Novosibirsk (Russian Federation). Inst. Yadernoj Fiziki); Matochkin, E.P. Comision Nacional de Energia Atomica, Buenos Aires (Argentina); International Atomic Energy Agency, Vienna (Austria); Secretaria de Ciencia y Tecnica, Buenos Aires (Argentina). 1990. [368] (CONF-900739–: 4. Latin American workshop on plasma physics, Buenos Aires (Argentina), 16-27 Jul 1990). In *Fourth Latin-American workshop on Plasma Physics (held in) Buenos Aires, Argentina, 16-27 Jul 1990. Contributed papers.* Order Number DE92635466. Source: OSTI; NTIS (US Sales Only); INIS.

Numerical experiments (PIC-method) were made to study the stochastic phenomena and the damping of the electric field by the interaction of Langmuir wave and ion-sound wave. (Author).

7182 (INIS-mf–13204, pp. 262-264) **Parametric amplification of waves in non-stationary plasma.** Krivitskij, V.S. (AN SSSR, Moscow (Russian Federation). Inst. Obshchej Fiziki); Vladimirov, S.V. Comision Nacional de Energia Atomica, Buenos Aires (Argentina); International Atomic Energy Agency, Vienna (Austria); Secretaria de Ciencia y Tecnica, Buenos Aires (Argentina). 1990. [368] (CONF-900739–: 4. Latin American workshop on plasma physics, Buenos Aires (Argentina), 16-27 Jul 1990). In *Fourth Latin-American workshop on Plasma Physics (held in) Buenos Aires, Argentina, 16-27 Jul 1990. Contributed papers.* Order Number DE92635466. Source: OSTI; NTIS (US Sales Only); INIS.

Using plasma as a nonlinear medium which can provide an amplification of electromagnetic radiation is of a sufficiently great interest now. Parametric amplification of oscillations connected with a nonstationary of the medium parameters is one of such mechanisms which may result in waves growing. To find a growth rate of such a 'parametric' wave amplification (resulting from the dependence $\epsilon_{\omega k}$(vector) (t) it is necessary to clarify how does the dielectric permittivity depend upon time. Namely, the general form of the (linear) connection between an induction D(t) and an intensity E(vector) (t) of the electric field is given. (Author).

7183 (INIS-mf–13204, pp. 359-362) **Optical diagnostics from plasmas produced in the compact toroid TC-I at UNICAMP.** Aramaki, E.A. (UNESP, Guaratingueta, SP (Brazil). Faculdade de Engenharia); Machida, M.; Honda, R.Y.; Porto, P.; Berni, L.A. Comision Nacional de Energia Atomica, Buenos Aires (Argentina); International Atomic Energy Agency, Vienna (Austria); Secretaria de Ciencia y Tecnica, Buenos Aires (Argentina). 1990. [368] (CONF-900739–: 4. Latin American workshop on plasma physics, Buenos Aires (Argentina), 16-27 Jul 1990). In *Fourth Latin-American workshop on Plasma Physics (held in) Buenos Aires, Argentina, 16-27 Jul 1990. Contributed papers.* Order Number DE92635466. Source: OSTI; NTIS (US Sales Only); INIS.

Following the works presented in the TC-I field reversed configuration device, this paper presents the results obtained from optical diagnostics as photodiode, IMACON, and spectrometry measurements. (Author).

7184 (INIS-mf–13204, pp. 302) **Analysis of free electron lasers with space charge field in the high gain regime.** Tsui, K.H. (Universidade Federal Fluminense, Niteroi, RJ (Brazil). Inst. de Fisica). Comision Nacional de Energia Atomica, Buenos Aires (Argentina); International Atomic Energy Agency, Vienna (Austria); Secretaria de Ciencia y Tecnica, Buenos Aires (Argentina). 1990. [368] (CONF-900739–: 4. Latin American workshop on plasma physics, Buenos Aires (Argentina), 16-27 Jul 1990). In *Fourth Latin-American workshop on Plasma Physics (held in) Buenos Aires, Argentina, 16-27 Jul 1990. Contributed papers.* Order Number DE92635466. Source: OSTI; NTIS (US Sales Only); INIS.

Short communication. FREE ELECTRON LASERS/ponderomotive force; FREE ELECTRON LASERS/space charge; ANALYTICAL SOLUTION; CHARGE DISTRIBUTION; ELECTROMAGNETIC FIELDS; HAMILTONIANS; LANGMUIR FREQUENCY; PHASE SPACE; PLASMA; PLASMA DENSITY

7185 (INIS-mf–13204, pp. 351-354) **Broadening of spectral lines of single ionized noble gases by plasmas.** Di Rocco, H.O. (Universidad Nacional del Centro de la Provincia de Buenos Aires, Tandil (Argentina). Facultad de Ciencias Exactas). Comision Nacional de Energia Atomica, Buenos Aires (Argentina); International Atomic Energy Agency, Vienna (Austria); Secretaria de Ciencia y Tecnica, Buenos Aires (Argentina). 1990. [368] (CONF-900739–: 4. Latin American workshop on plasma physics, Buenos Aires (Argentina), 16-27 Jul 1990). In *Fourth Latin-American workshop on Plasma Physics (held in) Buenos Aires, Argentina, 16-27 Jul 1990. Contributed papers.* Order Number DE92635466. Source: OSTI; NTIS (US Sales Only); INIS.

The Stark widths of ns-np transitions of the homologous sequence Ne II, Ar II, Kr II and Xe II follow a general trend in function of two relevant atomic parameters: the atomic number, Z and the upper level ionization potential, I; this role of I and Z is confirmed by line shifts experiments. For $N_e \geq 10^{17}$ cm^{-3}, a non linear dependence between Stark parameters and electron density exists: $w \approx N_e^{\delta}$; from the general trend, the value $\delta = 5/6$ is established. (Author).

7186 (INPE–4546) **Derivation of gyrotron's reduced equations and its application on the analysis of resonant cavities.** Correa, R.A.; Barroso, J.J.; Montes, A. Instituto de Pesquisas Espaciais (INPE), Sao Jose dos Campos, SP (Brazil). May 1988. [4] (PRE–1292.). Order Number DE93610279. Source: OSTI; NTIS (US Sales Only); INIS.

In this paper, it is presented a derivation of a reduced set of equations for the electron motion, based upon Lorentz equation, where the applicability conditions and approximations employed are clearly indicated. As an example of practical interest, scaling relations are discussed in the analysis of cavities appropriate for high efficiency operation. (author).

7187 (INPE–4550) **Observations of current flow to a positively polarized electrode in a quiescent magnetoplasma.** Ferreira, J.L.; Urrutia, J.M.; Stenzel, R.L. Instituto de Pesquisas Espaciais (INPE), Sao Jose dos Campos, SP (Brazil). May 1988. [4] (PRE–1296.). Order Number DE93610280. Source: OSTI; NTIS (US Sales Only); INIS.

This work reports experimental studies on the current flow to an electrode immersed in a quiescent magnetized plasma. The observed intense current driven instabilities during the current flow were found to be related with an anomalous current transport. (author).

7188 (INPE–5228) **Report of particle diffusion experimental study project in superficial confined plasma by magnetic multi dipole fields.** Ferreira, J.L.; Damasio, W.C.; Ferreira, J.C.; Sandonato, G.M.; Alves, M.V.; Montes, A.; Ludwig, G.O. Instituto de Pesquisas Espaciais (INPE), Sao Jose dos Campos, SP (Brazil). 28 Dec 1990. [51] (In Portuguese). (PRE–644.). Order Number DE93610246. Source: OSTI; NTIS (US Sales Only); INIS.

This work reports the activities of the experimental study group on plasma confinement. It discusses the study of diffusion coefficient, data acquisition systems and the use of electrostatic probes. (A.C.A.S.).

7189 (INPE–5259) **Neutral beam shinethrough in TBR-E.** Montes, A. Instituto de Pesquisas Espaciais (INPE), Sao Jose dos Campos, SP (Brazil). Jun 1991. [6] (PRE–1683.). Order Number DE93610281. Source: OSTI; NTIS (US Sales Only); INIS.

This work discusses the absorption of tangentially injected neutral beams in TBR-E. (A.C.A.S.).

7190 (INPE–5375) **Experimental study of coaxial resonators selective properties.** Castro, P.J.; Barroso, J.J.; Correa, R.A. Instituto de Pesquisas Espaciais (INPE), Sao Jose dos Campos, SP (Brazil). 1992. [9] (In Portuguese). (PRE–1748.). Order Number DE93610282. Source: OSTI; NTIS (US Sales Only); INIS.

This work studies the selective properties of open cylindrical coaxial cavities. The experimental results are compared to theory which includes ohmic effects. (A.C.A.S.).

7191 (IPP–1/269) **Interaction of relativistic electrons with plasma facing components.** Bartels, H.W. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Jul 1992. 31p. Order Number DE93742847. Source: OSTI; NTIS (US Sales Only); INIS.

Runaway electrons can cause severe damage to plasma facing components of large tokamaks. The designs proposed for the first wall and divertor of the next large fusion experiment, ITER (International Thermonuclear Experimental Reactor), are investigated. Energies of up to 300 MeV per electron and surface energy depositions of 30 MJ/m^2 are assumed. The GEANT code originating from high energy physics was used to model the energy deposition [J/cm^3] quantitatively as a function of the penetration depth and material. A two dimensional representation of the geometry was chosen. For the third coordinate the assumption of symmetric conditions is very close to reality. The magnetic field was included in the analysis. It causes bending back of reflected charged particles and reduced penetration depth of the electrons due to the gyration of the electrons around the magnetic field lines. The energy deposition in the bulk material for a given surface energy load is roughly independent of the incident angle and energy (above 100 MeV) since the main physical process of the energy loss is the formation of an electromagnetic shower, i.e. rapid dissipation of the initial energy into many electrons, positrons and photons. Typical divertor designs protect the cooling tubes with a 1 cm thick graphite layer. Melting of such molybdenum (copper) cooling tubes occurs at a heat load of 50 (25) MJ/m^2. Every additional cm of graphite roughly doubles the runaway protection. Since it is proposed to operate ITER with low cooling water temperatures (T_{H2O} < 150deg C), water pressurization due to runaway electron impact is not a serious problem if the cooling pipes do not melt. If the first material facing the plasma is metallic, melting must be expected for heat loads of around 20 MJ/m^2. (orig.).

7192 (IYaF–90-143) **Gasdynamics of dense plasma bunches in a solenoid.** Ryutov, D.D. AN SSSR, Novosibirsk (Russian Federation). Inst. Yadernoj Fiziki. 1990. [23] (In Russian). Order Number DE93610283. Source: OSTI; NTIS (US Sales Only); INIS.

To investigate plasma heating in solenoids a system of gas dynamics equations, corresponding to the parabolic pressure profile, is solved. The problem of multilayer plasma bunch motion, when the broadening of the internal bunch part leads to the acceleration of external layers consisting of the material with high atomic weight is considered. 15 refs.

7193 (JAERI-M–92-064) **Bootstrap current profiles and scaling in large aspect ratio tokamaks.** Fujisawa, Noboru (Japan Atomic Energy Research Inst., Naka, Ibaraki (Japan). Naka Fusion Research Establishment); Takizuka, Tomonori. Japan Atomic Energy Research Inst., Tokyo (Japan). May 1992. 19p. Order Number DE93753158. Source: OSTI; NTIS; INIS.

Recently, bootstrap currents, generated spontaneously in a tokamak plasma, have been observed in large tokamak devices. Those bootstrap currents are applied to designs of a next-generation experimental tokamak reactor like ITER and following tokamak power reactors. A simple expression for a bootstrap current of a tokamak with a large aspect ratio is proposed, which can easily evaluate the bootstrap current. Some empirical scalings for a bootstrap current with a finite aspect ratio have been proposed so far, and the applicability of them is briefly discussed. (J.P.N.).

7194 (JAERI-M–92-107) **Moment approach to fast ion neoclassical transport and viscous forces.** Wang, Jian-Ping (Japan Atomic Energy Research Inst., Naka, Ibaraki (Japan). Naka Fusion Research Establishment); Azumi, Masafumi; Tani, Keiji; Callen, J.D. Japan Atomic Energy Research Inst., Tokyo (Japan). Jul 1992. 34p. Order Number DE93753305. Source: OSTI; NTIS; INIS.

Fast ion drift kinetic equation is analytically solved in banana regime using a pitch-angle scattering eigenfunction expansion method. The analytical solution of this eigenfunction is made feasible by adopting Cordey's model [Nucl. Fusion 16, 499 (1976)] whereof the flux-surface averaged pitch-angle $\langle \nu_{parallel}/\nu \rangle$ is replaced by ξ, the pitch-angle at the minimum magnetic field. Then, the flux-surface averaged parallel viscous and heat viscous forces, $\langle B\cdot\nabla\cdot\Pi_{parallel} \rangle$ and $\langle B\cdot\nabla\cdot\Theta_{parallel} \rangle$, are calculated from the drift-kinetic solution to provide the key closure moments which give rise to radial neoclassical transport and bootstrap current. In combination with the recently derived fast ion friction forces, a moment approach is schemed for fusion plasmas with significant fraction of fast ion component. A new orthogonal polynomial expansion method is presented for the fluid flow distortion from an isotropic distribution and applied to expressing the friction forces between fast ions and thermal ions. (author).

7195 (JET-R–91-11, pp. 3-13) **Destruction of drift surfaces in tokamaks through small magnetic field perturbations.** Duechs, D.F. (Commission of the European Communities, Abingdon (United Kingdom). JET Joint Undertaking); Montvai, A. Commission of the European Communities, Abingdon (UK). JET Joint Undertaking. Nov 1991. (CONF-9106370–: 4. European fusion theory conference, Aspenaes (Sweden), 17-19 Jun 1991). In *Contributions to 4th European fusion theory conference (Aspenaes, Sweden, 17th-19th June 1991).* [114] Order Number DE92639125. Source: OSTI; NTIS (US Sales Only); INIS.

In tokamak discharges magnetic field perturbations usually seem too small to cause a global destruction of flux surfaces. Perturbations, however, can modify globally the shape of the flux surfaces and thus influence particle orbits (e.g. through enhanced field curvature and gradients drifts, etc.). This influence was investigated

especially for cases of field perturbations which are toroidally asymmetric (and "non-periodic"). In these cases particle trajectory invariants (such as toroidal angular momentum, adiabatic invariants, etc.), which are basic for conventional plasma transport theories, are not necessarily available. It turns out that, although the magnetic field does form flux surfaces, the drift surfaces do not in general exist, what can be constructed as "anomalous transport". To quantify these effects accurate magnetic fields are computed using new mapping techniques. Particles are followed both directly and in drift approximation. As special cases perturbations are chosen imposed on a tokamak plasma by neutral beam injection and by faults in the toroidal field coils. It is estimated that the derived coefficients (χ, D) are in the range of the observed values for rather modest perturbation amplitudes. (Author).

7196 (JET-R–91-11, pp. 77-99) **Non-linear regimes in resistive MHD equations.** Tebaldi, C. (Commission of the European Communities, Abingdon (United Kingdom). JET Joint Undertaking). Commission of the European Communities, Abingdon (UK). JET Joint Undertaking. Nov 1991. (CONF-9106370–: 4. European fusion theory conference, Aspenaes (Sweden), 17-19 Jun 1991). In *Contributions to 4th European fusion theory conference (Aspenaes, Sweden, 17th-19th June 1991).* [114] Order Number DE92639125. Source: OSTI; NTIS (US Sales Only); INIS.

The resistive MHD equations in "slab" geometry and helical symmetry are considered in a dissipative dynamical system approach with the aim to elucidate the basic mechanisms for the non-linear regimes in plasmas. One-dimensional equilibria are found to be destabilised via symmetry breaking bifurcation to stationary solutions with "island-vortex" structures. Conditions are discussed for which further destabilisation to time-dependent regimes at higher Reynolds number leads to "sawtooth-like" oscillations. The "crash" in magnetic energy is found to be due to a fast drop for the one-dimensional magnetic field connected with enhancement of "island-vortex" activity. (Author).

7197 (JET-R–91-11, pp. 17-41) **Modelling of ICRH on JET.** Eriksson, L.-G. (Commission of the European Communities, Abingdon (United Kingdom). JET Joint Undertaking). Commission of the European Communities, Abingdon (UK). JET Joint Undertaking. Nov 1991. (CONF-9106370–: 4. European fusion theory conference, Aspenaes (Sweden), 17-19 Jun 1991). In *Contributions to 4th European fusion theory conference (Aspenaes, Sweden, 17th-19th June 1991).* [114] Order Number DE92639125. Source: OSTI; NTIS (US Sales Only); INIS.

Simplified models of ICR heating on the JET tokamak are developed in order to reduce computing time to reasonable levels. (UK).

7198 (JET-R–91-11, pp. 45-51) **Broadening of ICRH produced fast ion profiles due to orbit effects.** Eriksson, L.-G. (Commission of the European Communities, Abingdon (United Kingdom). JET Joint Undertaking); Porcelli, F. Commission of the European Communities, Abingdon (UK). JET Joint Undertaking. Nov 1991. (CONF-9106370–: 4. European fusion theory conference, Aspenaes (Sweden), 17-19 Jun 1991). In *Contributions to 4th European fusion theory conference (Aspenaes, Sweden, 17th-19th June 1991).* [114] Order Number DE92639125. Source: OSTI; NTIS (US Sales Only); INIS.

In the JET tokamak, minority ions accelerated by ICRH reach energies in the MeV range. Near the plasma magnetic axis, the standard trapped particle "banana" orbit is distorted into a "potato" or "fat banana" orbit. The zero banana width approximation which is used in most Fokker-Planck calculations of velocity distributions of resonating ions is often not valid in JET. The inclusion of finite banana width effects will, in general, lead to a lowering of the averaged tail energy and a broadening of pressure profiles, power transfer profiles etc. A model for calculating orbit broadened profiles is presented. (Author).

7199 (JET-R–91-11, pp. 55-68) **Monte-Carlo study of high power (D)T ICRF heating in JET.** Kovanen, M.A. (Commission of the European Communities, Abingdon (United Kingdom). JET Joint Undertaking). Commission of the European Communities, Abingdon (UK). JET Joint Undertaking. Nov 1991. (CONF-9106370–: 4. European fusion theory conference, Aspenaes (Sweden), 17-19 Jun 1991). In *Contributions to 4th European fusion theory conference (Aspenaes, Sweden, 17th-19th June 1991).* [114] Order Number DE92639125. Source: OSTI; NTIS (US Sales Only); INIS.

A Monte-Carlo investigation of the high power fundamental minority (D)T ICRF heating in JET is undertaken. The effect of the minority ion concentration, the location of the resonance layer, the symmetry of the wave field spectrum, the background ion temperature and the α-particle absorption of the ICRF power on the fusion yield is assessed in a projected pellet injected reference discharge ($n_e(0)$ $10^{20}m^{-3}$, $T_e(0)$ = 12 keV, $T_i(0)$ = 10 keV, P_{rf} = 25 MW, (P_D + $P_\alpha)_{abs}/P_{rf}$ 80%). Even with $n_D/n_e \approx$ 30%, which is needed for high fusion yield, the finite orbit width and its related transport effects, such as the banana drift, and the RF induced diffusion and drift, are important and strongly reduce the attainable yield. However, as here the transferred power to background ions dominates over the power to electrons, the increased target triton temperature can significantly improve the yield and achieving Q (=P_{fus}/P_{rf}) =1 in JET would appear to be feasible. The use of the asymmetric wave field spectrum improves the confinement of the resonating ions and is shown to substantially enhance the yield and the duration time of the peak yield value. This effect, if also applied to tritons could delay the characteristic deterioration of the peaked density profiles during the pellet-enhanced-performance (PEP) modes α-particle absorption of the RF power was found to be very small. (Author).

7200 (JET-R–91-11, pp. 71-74) **Different forms of the energy conservation equation, or is energy convection 5/2 kTΓ or 3/2 kTΓ?.** Stringer, T.E. (Commission of the European Communities, Abingdon (United Kingdom). JET Joint Undertaking). Commission of the European Communities, Abingdon (UK). JET Joint Undertaking. Nov 1991. (CONF-9106370–: 4. European fusion theory conference, Aspenaes (Sweden), 17-19 Jun 1991). In *Contributions to 4th European fusion theory conference (Aspenaes, Sweden, 17th-19th June 1991).* [114] Order Number DE92639125. Source: OSTI; NTIS (US Sales Only); INIS.

The convection of kinetic energy is 5/2 kTΓ, but the physically more meaningful total energy (kinetic + potential) convects as 3/2 kTΓ. The energy flux derived from interpretive transport analysis codes is closer to the latter. (Author).

7201 (JET-R–91-11, pp. 103-114) **Neoclassical impurity flux in the presence of anomalous transport.** Stringer, T.E. (Commission of the European Communities, Abingdon (United Kingdom). JET Joint Undertaking). Commission of the European Communities, Abingdon (UK). JET Joint Undertaking. Nov 1991. (CONF-9106370–: 4. European fusion theory conference, Aspenaes (Sweden), 17-19 Jun 1991). In *Contributions to 4th European fusion theory conference (Aspenaes, Sweden, 17th-19th June 1991).* [114] Order Number DE92639125. Source: OSTI; NTIS (US Sales Only); INIS.

The argument which leads to automatic ambipolarity of neoclassical transport is re-examined. When electrostatic fluctuations are present, as they always are experimentally, neoclassical transport is shown not to be ambipolar. It is pointed out that the anomalous transport driven by electrostatic turbulence is not ambipolar, because of the FLR reduction in the ion electric drift. (Author).

7202 (JET-R–92-03) **Dynamics of a steady-state D-T burning tokamak plasma.** Bickerton, R.J. Commission of the European Communities, Abingdon (UK). JET Joint Undertaking. May 1992. [26] Order Number DE93610284. Source: OSTI; NTIS (US Sales Only); INIS.

A tokamak fusion reactor is expected to operate in steady state for long periods, preferably for weeks on end using efficient, non-inductive current drive. The plasma must be kept free of significant contamination by helium ash and new fuel must be supplied to maintain the burn. In this note we survey some of the problems, particularly those relating to the plasma physics in the discharge. (author).

7203 (JET-R–92-06) **The Soft X-ray real time fast trigger system.** Blackler, K.; Edwards, A.; Holm, J. Commission of the European Communities, Abingdon (UK). JET Joint Undertaking. May 1992. [9] Order Number DE93610250. Source: OSTI; NTIS (US Sales Only); INIS.

Most current diagnostics are limited to recording data either at fixed times and data rates, or in response to certain predefined events - such as the injection of a pellet. The previous Soft X-Ray trigger system at Joint European Torus Joint Undertaking (JET)(A.W. Edwards et al., Rev Sci Instrum. 57(8), p2142, 1986) improved upon this by using Analogue Signal Processors to monitor the analogue data in real time and to provide 'triggers' to the data acquisition system in response to an event such as a sawtooth collapse. This system was however limited in the type of events that could be detected. It was also incapable of being rapidly reconfigured. Advances in digital electronics caused a study to be undertaken to see if this situation could be improved. The system described below is the result of this study and has successfully run at JET since the summer of 1990, providing a greatly increased quality of data as well as recording some new phenomena such as the spontaneous snake. This note has been produced to describe the function and operation of the trigger system. (author).

7204 (KFTI–90-7) **Study on plasma equilibrium currents in l-3 torsatron.** Kalyuzhnyj, V.N.; Nemov, V.V. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. [24] (In Russian). Order Number DE93610247. Source: OSTI; NTIS (US Sales Only); INIS.

Using numerical methods study of plasma equilibrium currents in magnetic configurations of l-3 torsatron depending on the law of reeling its winding and the value of additional uniform vertical magnetic field is carried out. 13 refs.; 4 figs.; 4 tabs.

7205 (KFTI–90-8) **Transfer processes in stellarators at the regime of frequent particle collisions.** Nemov, V.V. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. [16] (In Russian). Order Number DE93610253. Source: OSTI; NTIS (US Sales Only); INIS.

Method of studying particle and heat fluxes in stellarators in the regime of frequent particle collisions and allowing for real geometry of their magnetic field is considered. 10 refs.; 2 figs.; 1 tab.

7206 (KFTI–90-9) **On a mechanism of antenna phasing effect on impurity production during ICRF plasma heating.** Chechkin, V.V.; Grigor'eva, L.I. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. [15] Order Number DE93610263. Source: OSTI; NTIS (US Sales Only); INIS.

An appreciable reduction of the metal impurity in flux and a decrease in SOL plasma parameter disturbance occure during ICRP heating in some tokamaks when toroidally adjacent antennae are driven in anti-phase. Also cancelled are low-frequency electric field fluctuations arising in the sheaths and the associated charged particle flux fluctuations. 24 refs.; 7 figs.

7207 (KFTI–90-14) **Disintegration of fast magnetoacoustic oscillation spectra in non-uniform current-loaded plasma cylinder.** Girka, I.A.; Stepanov, K.N. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. [19] (In Russian). Order Number DE93610257. Source: OSTI; NTIS (US Sales Only); INIS.

Dispersion equation for fast plasma cylinder with longitudinal current including a weak azimuthal magnetic field β_{0v} is obtained and analyzed on the basis of perturbation theory. Simple asymptotic expressions for S_w, S_n and σ_k are derived under different limiting cases (propagation of small-scale waves with high values of radial wave number, wave in the uniform cylinder, surface mode etc.). 10 refs.; 1 fig.

7208 (KFTI–90-15) **Excitation of oscillation at interaction of electron beam with producting plasma.** Bliokh, Yu.P.; Zemlyanskij, N.M.; Lyubarskij, M.G.; Mirnyj, V.I.; Onishchenko, I.N.; Fajnberg, Ya.B. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. [8] (In Russian). Order Number DE93610258. Source: OSTI; NTIS (US Sales Only); INIS.

Results of theoretical and experimental investigations of peculiarities of electron beam interaction with producing plasma, not inherent to the beam interaction with independently produced highly ionized plasma are presented. 4 refs.; 3 figs.

7209 (KFTI–90-16) **Plasma-beam interaction at the presence of ion acoustic wave.** Bliokh, Yu.P.; Lyubarskij, M.G.; Podobinskij, V.O. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. [8] (In Russian). Order Number DE93610259. Source: OSTI; NTIS (US Sales Only); INIS.

Plasma-beam instability increment dependence on parameters of ion-acoustic wave, propagating in interaction region, is found. 2 refs.; 3 figs.

7210 (KFTI–90-19) **Theory of nonlinear interaction of potential oscillations of radially homogeneous rotating plasma.** Mikhajlenko, V.S.; Stepanov, K.N.; Chibisov, D.V. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. [12] (In Russian). Order Number DE93610260. Source: OSTI; NTIS (US Sales Only); INIS.

Formalism of iterative solution of Vlasov-Poisson equation system, which is based on using action-angle variables is developed. 12 refs.

7211 (KFTI–90-20) **Cyclotron and drift instabilities of rotating plasma.** Mikhajlichenko, V.S.; Stepanov, K.N.; Chibisov, D.V. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. [15] (In Russian). Order Number DE93610261. Source: OSTI; NTIS (US Sales Only); INIS.

Linear theory of small-scale kinetic and hydrodynamic ion cyclotron and drift instabilities of weakly-nonuniform slowly rotating plasma is developed. Possible saturation levels of considered instabilities are determined, velocity of ion component turbulent heating is estimated. 16 refs.

7212 (KFTI–90-21) **Ion cyclotron turbulence of rotating plasma.** Mikhajlenko, V.S.; Stepanov, K.N.; Chibisov, D.V. AN Ukrainskoj SSR, Kharkov (Ukraine). Fiziko-Tekhnicheskij Inst. 1990. [11] (In Russian). Order Number DE93610262. Source: OSTI; NTIS (US Sales Only); INIS.

Study of nonlinear evolution of ion cyclotron turbulence of rotating plasma on the basis of equation construction for spectral intensity of cylindrical waves is carried out. Spectral evolution of small-scale ion cyclotron waves is studied, the saturation level of ion cyclotron turbulence of rotating plasma is determined. 3 refs.; 2 figs.

7213 (LA-UR–92-3765) **Experimental studies of instabilities in radially imploding plasmas.** Oona, H.; Bowers, R.L.; Peterson, D.L.; Findley, C.; Cohrane, J.C.; Ladish, J.S. Los Alamos National Lab., NM (United States). [1992]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-921133–4: 6. international conference on megagauss magnetic field generation and related topics, Albuquerque, NM (United States), 9-12 Nov 1992). Order Number DE93003831. Source: OSTI; NTIS; INIS; GPO Dep.

In this paper we present experimental data from two experiments that show the initation and growth of the instabilities and compare them to a two dimensional radiational magnetohydrodynamic (RMHD) computation. High-speed cameras (Imacons) were used to observe the implosion as the plasma converges and stagnates on axis. Computer-image enhancement was used to determine the periodicity and amplitude of the initial perturbations. In the two experimental cases, the 5-cm-radius implosion foils had mass of 4.2 and 12.6 milligrams. The data show that the larger mass evolves into a more uniform implosion. Also, we determine the implosion velocity and the growth rate of a selected perturbation.

7214 (LA-UR–92-3774) **Nonlinear interaction of magnetohydrodynamic instabilities in radially imploded plasmas.** Bowers, R.L.; Brownell, J.H.; Greene, A.E.; Kruse, H.; Oona, H.; Peterson, D.L. Los Alamos National Lab., NM (United States). [1992]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-921133–1: 6. international conference on megagauss magnetic field generation and related topics, Albuquerque, NM (United States), 9-12 Nov 1992). Order Number DE93003834. Source: OSTI; NTIS; INIS; GPO Dep.

The magnetic implosion of cylindrical, conducting loads has been used in pulsed power experiments for decades as a source of soft x-rays. In the Los Alamos foil implosion project we have designed and fielded experiments with thin aluminum foils which have been driven in direct drive mode, or which have employed a fast opening switch in the final pulse tailoring stage. In this paper we discuss computational modeling and the results of several experiments in

which 4.24 mg and 12.7 mag aluminum loads were imploded in direct drive mode. In these experiments the load was at an initial radius of 5.0 cm, and the bank delivered about 3 MA to it during the implosion. One-dimensional (1-D) model of these implosions generally predict efficient conversion of magnetic energy into x-ray output and radiation pulsewidths that are very short.

7215 (NIFS–127) **Energy transport in the steady state plasma sustained by DC helicity current drive.** Itoh, K.; Itoh, S.; Fukuyama, A. National Inst. for Fusion Science, Nagoya (Japan). Jan 1992. 18p. Order Number DE93753084. Source: OSTI; NTIS; INIS.

Steady state operation of tokamaks which is sustained by the DC helicity current drive near edge is studied. The necessary value of the current diffusivity is obtained. Relation between the current diffusivity and the thermal diffusivity, which are governed by the microscopic turbulence, indicates that this requires too large thermal transport for the parameters in present day experiments. (author).

7216 (NIFS–129) **Line-emission cross sections for the charge-exchange reaction between fully stripped carbon and atomic hydrogen in tokamak plasma.** Ida, K.; Kato, T. National Inst. for Fusion Science, Nagoya (Japan). Jan 1992. 23p. Order Number DE93753085. Source: OSTI; NTIS; INIS.

Line-emission cross sections of the charge-exchange reaction between fully stripped carbon and atomic hydrogen are measured in the energy range of 18 - 38 keV/amu in tokamak plasmas. The energy dependence of the emission cross sections for the transition of $\Delta n = 8 - 7$ and $\Delta n = 7 - 6$ and their ratios are compared with theoretical calculations. (author).

7217 (NIFS–130) **Magnetic surface breaking in 3D MHD equilibria of l=2 Heliotron.** Hayashi, Takaya; Takei, Akira; Sato, Tetsuya. National Inst. for Fusion Science, Nagoya (Japan). Jan 1992. 32p. Order Number DE93753087. Source: OSTI; NTIS; INIS.

Magnetic surface breaking due to the finite pressure effect is analyzed for three dimensional magnetohydrodynamic equilibria of l=2 Heliotron configuration. Characteristics of magnetic island formation are extensively surveyed. It is found that the well-hill criterion which has been predicted by the local analysis is not always applicable for all cases. (author).

7218 (NIFS–131) **Beta limit of resistive plasma in Torsatron /Heliotron.** Itoh, K.; Ichiguchi, K.; Itoh, S.I. National Inst. for Fusion Science, Nagoya (Japan). Feb 1992. 24p. Order Number DE93753086. Source: OSTI; NTIS; INIS.

Stability against the interchange mode in the Torsatron /Heliotron device is investigated, taking into account the effects of the resistivity, current diffusivity, ion viscosity and thermal diffusivity. Critical beta for the low-mode-number stability is found at the finite beta value. For the range of plasma parameters of the present experiments, the resistive mode and current diffusive mode set comparable critical beta values, which are consistent with experimental observations. In future high temperature plasmas, the current diffusive mode determines the stability limit for the global mode. (author).

7219 (NIFS–133) **Superposed-laser electron acceleration.** Maruyama, T. (Nagaoka Univ. of Technology, Niigata (Japan)); Kawata, S. National Inst. for Fusion Science, Nagoya (Japan). Feb 1992. 22p. Order Number DE93753306. Source: OSTI; NTIS; INIS.

A new mechanism is proposed for electron acceleration by using two superposed laser beams in vacuum. In this mechanism, an electron is accelerated by the longitudinal component of the wave electric field in the overlapped region of two laser beams. Single-particle computations and analytical works are performed in order to demonstrate the viability. These results show that the electron can be accelerated well in this proposed mechanism. (author).

7220 (NIFS–134) **Rapid change of hydrogen neutral energy distribution at L/H-transition in JFT-2M H-mode.** Miura, Y. (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Okano, F.; Suzuki, N.; Mori, M.; Hoshino, K.; Maeda, H.; Takizuka, T.; Itoh, S.; Itoh, K. National Inst. for Fusion Science, Nagoya (Japan). Feb 1992. 22p. Order Number DE93753307. Source: OSTI; NTIS; INIS.

Rapid changes of the main ion energy distribution at transitions from L-to-H, H-to-L and during ELMs are studied with the time of flight neutral measurement on the JFT-2M tokamak. At the L to H transition, 200-400μs prior to the start of H_α drop, an increase of the high energy outflux above an energy of 200eV is observed. An energy of more than 200eV for hydrogen corresponds to the collisionless condition $\nu^*_i < 1$ just inside the separatrix. The change of the energy distribution precedes that of the H_α signal and is also found for ELMs and the H to L transition. (author).

7221 (NIFS–135) **Fluctuation and edge current sustainment in a reversed-field-pinch.** Ji, H. (Tokyo Univ. (Japan). Dept. of Physics); Toyama, H.; Fujisawa, A.; Shinohara, S.; Miyamoto, K. National Inst. for Fusion Science, Nagoya (Japan). Feb 1992. 20p. Order Number DE93753308. Source: OSTI; NTIS; INIS.

Simple Ohm's law ηjparallel = Eparallel is not satisfied in a/2 < or approx. r $\leq$ a region of the REPUTE-1 RFP plasma. Fluctuation-induced electric fields, such as <v tilde x B tilde>, are not sufficient to account for ηjparallel - Eparallel at the edge. It is implied that current-diffusions due to magnetic fluctuations, carried by fast electrons rather than bulk cold electrons, sustain the edge parallel equilibrium current. (author).

7222 (NIFS–136) **Heat flow of a two-electron-temperature plasma through the sheath in the presence of electron emission.** Sato, Kunihiro (Himeji Inst. of Tech., Hyogo (Japan)); Miyawaki, Fujio. National Inst. for Fusion Science, Nagoya (Japan). Mar 1992. 19p. Order Number DE93753309. Source: OSTI; NTIS; INIS.

The electrostatic sheath and the heat flow of a two-electron-temperature plasma in the presence of electron emission is investigated analytically. It is shown that the energy flux is remarkably enhanced up to a value near the electron free-flow energy flux as a result of considerable reduction of the sheath potential due to electron emission if the fraction of hot electrons at the sheath edge is much smaller than one. If the hot- to cold-electron temperature is of the order of ten and the hot electron density is comparable with the cold electron density, the action of the sheath as a thermal insulator is improved as a result of suppression of electron emission due to the space-charge effect of hot electrons. (author).

7223 (NIFS–137) **Field line diversion properties of finite β Helias equilibria.** Hayashi, T.; Schwenn, U.; Strumberger, E. National Inst. for Fusion Science, Nagoya (Japan). Mar 1992. 17p. Order Number DE93753310. Source: OSTI; NTIS; INIS.

The diversion properties of the magnetic field outside the last closed magnetic surface of a Helias stellarator configuration are investigated for finite β-equilibria. The results support a divertor concept which has been developed from the diversion properties of the corresponding vacuum field. Cross-field transport is simulated by a simplified scrape-off layer (SOL) model. (author).

7224 (NIFS–139) **Three-dimensional MHD equilibrium in the presence of bootstrap current for Large Helical Device (LHD).** Watanabe, K. (Kyoto Univ. (Japan). Faculty of Engineering); Nakajima, N.; Okamoto, M.; Nakamura, Y.; Wakatani, M. National Inst. for Fusion Science, Nagoya (Japan). Mar 1992. 45p. Order Number DE93753311. Source: OSTI; NTIS; INIS.

Three-dimensional MHD equilibria including the bootstrap current self-consistently are studied for the Large Helical Device (LHD). Magnitude of the bootstrap current is sensitive to the magnetic axis position or Shafranov shift in LHD, which is proportional to the plasma pressure and inversely proportional to the rotational transform. Since the bootstrap current enhances the rotational transform and reduces Shafranov shift, the self-consistent MHD equilibrium is crucial to estimate the bootstrap current. Total bootstrap current easily exceeds 100kA for LHD plasmas with $<\beta> >$ or approx. 1% under the assumption that both electrons and ions belong to the rare-collisional $1/\nu$ regime in the whole plasma region, where $<\beta>$ is a volume averaged beta value. Effects of the vertical field, the quadrupole field and the pressure profile on the bootstrap current are also investigated. (author).

7225 (NIFS–141) **Internal structures of self-organized relaxed states and self-similar decay phase.** Kondoh, Yoshiomi (Gunma Univ., Kiryu (Japan). Faculty of Technology). National Inst.

for Fusion Science, Nagoya (Japan). Mar 1992. 44p. Order Number DE93753312. Source: OSTI; NTIS; INIS.

A thought analysis on relaxation due to nonlinear processes is presented to lead to a set of general thoughts applicable to general nonlinear dynamical systems for finding out internal structures of the self-organized relaxed state without using 'invariant'. Three applications of the set of general thoughts to energy relaxations in resistive MHD plasmas, incompressible viscous fluids, and incompressible viscous MHD fluids are shown to lead to the internal structures of the self-organized relaxed states. It is shown that all of the relaxed states in these three dynamical systems are followed by self-similar decay phase without significant change of the spatial structure. The well known relaxed state of $\nabla \times B = \pm\lambda B$ is shown to be derived generally in the low β plasma limit. (author).

7226 (NIFS–142) **Recombining processes in a cooling plasma by mixing of initially heated gas.** Furukane, Utaro (Ehime Univ., Matsuyama (Japan). Coll. of General Education); Sato, Kuninori; Takiyama, Ken; Oda, Toshiatsu. National Inst. for Fusion Science, Nagoya (Japan). Mar 1992. 35p. Order Number DE93753313. Source: OSTI; NTIS; INIS.

A numerical investigation of recombining process in a high temperature plasma in a quasi-steady state is made in a gas contact cooling, in which the initial temperature effect of contact gas heated up by the hot plasma is considered as well as the gas cooling due to the surrounding neutral particles freely coming into the plasma. The calculation has shown that the electron temperature relaxes in accord with experimental results and that the occurrence of recombining region and the inverted populations almost agree with the experimental ones. (author).

7227 (NIFS–143) **New method of error elimination in potential profile measurement of tokamak plasmas by high voltage heavy ion beam probes.** Hamada, Y.; Masai, K.; Kawasumi, Y.; Iguchi, H.; Fujisawa, A. National Inst. for Fusion Science, Nagoya (Japan). Apr 1992. 34p. Order Number DE93753194. Source: OSTI; NTIS; INIS.

The measurement of a potential profile in tokamak plasmas by heavy ion beam probe (HIBP) in a single shot is usually difficult, because as primary beam is swept through plasma cross-section, the secondary beam hits the input slit of an energy analyzer with a large variation in entrance angles (in-plane and out-plane). In this paper, a new method (the application of fast toroidal sweeps of the primary or the secondary beam at the analyzer or at an entrance to an tokamak) is proposed to eliminate the error due to the change in the entrance angle. In addition, results of a new calibration method of HIBP in tokamak (electron stripping by neutral gas) are presented. (author).

7228 (NIFS–145) **Coupling to the lower hybrid waves with the multijunction grill.** Ohkubo, Kunizo; Matsumoto, Kazunori. National Inst. for Fusion Science, Nagoya (Japan). May 1992. 39p. Order Number DE93753196. Source: OSTI; NTIS; INIS.

Coupling characteristics of the multijunction grill have been studied theoretically and experimentally by using a multireflection method with the aid of scattering matrices not only at the junction plane but also at the grill mouth. The global reflection coefficients in the primary waveguide and secondary wave-guides can be estimated from the vector sum of reflecting components caused by each reflection between two scattering planes. The experimental results of scattering matrices and the global coupling agree well with calculated ones. It is shown that the multiple reflection in secondary waveguides of the four-junction grill for JIPPT-IIU tokamak is finished until three or four reflections. The length of the secondary waveguides is confirmed to be one of parameters determining the grill efficiency. (author).

7229 (NIFS–146) **A model of major disruption in tokamaks.** Itoh, Kimitaka; Itoh, Sanae; Fukuyama, Atsushi; Tsuji, Shunji; Lichtenberg, A.J. National Inst. for Fusion Science, Nagoya (Japan). May 1992. 22p. Order Number DE93753197. Source: OSTI; NTIS; INIS.

A mechanism for the onset of the major disruption is proposed which considers the effect of magnetic stochasticity on the growth of the m=2 tearing mode. The toroidicity can cause stochasticity near the separatrix of the m=2 magnetic island which enhances the current viscosity, resulting in explosive growth. The threshold condition and the time scale of rapid growth are studied. The role of the toroidal coupling to the m=1 component is also discussed. (author).

7230 (NIFS–147) **Edge plasma density reconstruction for fast monoenergetic lithium beam probing.** Sasaki, S. (Nagoya Univ. (Japan). Faculty of Engineering); Takamura, S.; Ueda, M.; Iguchi, H.; Fujita, J.; Kadota, K. National Inst. for Fusion Science, Nagoya (Japan). May 1992. 25p. Order Number DE93753198. Source: OSTI; NTIS; INIS.

Two types of plasma density reconstruction methods for fast Li^0 beam probe diagnostics have been developed for edge profile measurements in the CHS helical device, in which density dependence of atomic processes such as ionization, excitation/deexcitation and charge exchange is introduced by the use of effective rate coefficients calculated from collisional radiative model. These methods enable us to get plasma density profile well inside the last closed flux surface (LCFS) for various range of plasma densities with considering attenuation of the fast Li^0 beam and using effective rate coefficients. A new method (method-I) can unfold the plasma density profiles from a fractional part of emission profile of Li I resonance line. The second method (method-II) reconstructs the density profile from the whole range of emission profile including signal tail-off region due to the beam attenuation. These two methods, which introduce density dependence of atomic processes and the beam attenuation caused by ionization, noticeably improve the precision of the measurements and extend the applicable density region of the plasma. Density profiles reconstructed by these two different methods have shown good agreement each other and are consistent with the result of ruby laser Thomson scattering. (author).

7231 (NIFS–148) **High-n helicity-induced shear Alfven eigenmodes.** Nakajima, N.; Cheng, C.Z.; Okamoto, M. National Inst. for Fusion Science, Nagoya (Japan). May 1992. 29p. Order Number DE93753199. Source: OSTI; NTIS; INIS.

The high-n Helicity-induced shear Alfven Eigenmodes (HAE) are considered both analytically and numerically for the straight helical magnetic system, where n is the toroidal mode number. The eigenmode equation for the high-n HAE modes is derived along the field line and with the aid of the averaging method is shown to reduce to the Mathieu equation asymptotically. The discrete HAE modes are shown to exist inside the continuum spectrum gaps. The continuous spectrum gaps appear around $\omega^2 = \omega_A^2[N(l\iota\text{-}m)/2]^2$ for N = 1,2,.., where ω_A is the toroidal Alfven transit frequency, and l, m, and ι are the polarity of helical coils, the toroidal pitch number of helical coils, and the rotational transform, respectively. For the same ω_A and ι, the frequency of the helical continuum gap is larger than that of the continuum gap in tokamak plasmas by $\frac{}{}\iota^{-1}m\frac{}{}$. The polarity of helical coils l plays a crucial role in determining the spectrum gaps and the properties of the high-n HAE modes. The spectrum gaps near the magnetic axis are created by the helical ripple with circular flux surfaces for l = 1, and $\geq$ 3 helicals. For l = 2 helical systems, the spectrum gaps are created by the ellipticity of the flux surfaces. These analytical results for the continuum gaps and the existence of the high-n HAE modes in the continuum gaps are confirmed numerically for the l = 2 case, and we find that the HAE modes exist for mode structures with the even and the odd parities. (author).

7232 (NIFS–150) **Effects of fast ions and an external inductive electric field on the neoclassical parallel flow, current, and rotation in general toroidal systems.** Nakajima, Noriyoshi; Okamoto, Masao. National Inst. for Fusion Science, Nagoya (Japan). May 1992. 26p. Order Number DE93753201. Source: OSTI; NTIS; INIS.

Effects of external momentum sources, i.e., fast ions produced by the neutral beam injection and an external inductive electric field, on the neoclassical ion parallel flow, current, and rotation are analytically investigated for a simple plasma in general toroidal systems. It is shown that the contribution of the external sources to the ion parallel flow becomes large as the collision frequency of thermal ions increases because of the momentum conservation of Coulomb collisions and sharply decreasing viscosity coefficients, with collision frequency. As a result, the beam-driven parallel flow of

thermal ions becomes comparable to that of electrons in the Pfirsh-Schluter collisionality regime, whereas in the $1/\mu$ or banana regime it is smaller than that of electrons by the order of $\sqrt{(m_e/m_i)}$ (m_e and m_i are electron and ion masses). This beam-driven ion parallel flow can not produce a large beam-driven current because of the cancellation with electron parallel flow, but produces a large toroidal rotation of ions. As both electrons and ions approach the Pfirsh-Schluter collisionality regime the contribution of thermodynamical forces becomes negligibly small and the large toroidal rotation of ions is predominated by the beam-driven component in the non-axisymmetric configuration with large helical ripples. (author).

7233 (NIFS–153) **On a ballistic method for double layer regeneration in a Vlasov-Poisson plasma.** Bazdenkov, S.V.; Sato, Tetsuya. National Inst. for Fusion Science, Nagoya (Japan). Jun 1992. 30p. Order Number DE93753314. Source: OSTI; NTIS; INIS.

Double layers generated by a current-driven instability are usually alive short time and destroyed by emitting solitons and other nonlinear waves. It is analytically shown that they can be regenerated in one-dimensional Vlasov-Poisson plasma system where the upstream velocity distribution is swiftly heated to restore an unstable condition in the downstream region due to ballistic deformation. (author).

7234 (NIFS–154) **On the Lagrangian of the linearized MHD equations.** Todoroki, Jiro. National Inst. for Fusion Science, Nagoya (Japan). Jun 1992. 12p. Order Number DE93753315. Source: OSTI; NTIS; INIS.

Lagrangian for the linearized, ideal and resistive, MHD equations is discussed, by introducing the perturbation of the total pressure. In the resistive MHD equations, the Lagrangian is expressed in terms of the electric displacement vector (time integral of the electric current) as well as the plasma displacement. The NOVA and NOVA-R formulation can be derived by using the obtained Lagrangian. (author).

7235 (NIFS–162) **Refined theory of diamagnetic effect in stellarators.** Pustovitov, V.D. National Inst. for Fusion Science, Nagoya (Japan). Aug 1992. 22p. Order Number DE93754332. Source: OSTI; NTIS; INIS.

The difference $\delta\Phi$ between toroidal magnetic flux Φ_p through the plasma cross-section and the same flux Φ_v of a vacuum magnetic field is calculated analytically for 'conventional' stellarators with planar circular axis. It has been done without limitations of aspect ratio, shape and position of a plasma. The results obtained show weak dependence of $\delta\Phi/\Phi$ on the geometry of equilibrium configuration. It proves that diamagnetic measurements can be considered as a reliable basis for the direct evaluation of stored plasma energy at various experimental conditions. (author).

7236 (NIFS–164) **Thought analysis on self-organization theories of MHD plasma.** Kondoh, Yoshiomi (Gunma Univ., Kiryu (Japan). Faculty of Technology); Sato, Tetsuya. National Inst. for Fusion Science, Nagoya (Japan). Aug 1992. 60p. Order Number DE93754333. Source: OSTI; NTIS; INIS.

A thought analysis on the self-organization theories of dissipative MHD plasma is presented to lead to three groups of theories that lead to the same relaxed state of $\nabla \times B = \lambda B$, in order to find an essential physical picture embedded in the self-organization phenomena due to nonlinear and dissipative processes. The self-organized relaxed state due to the dissipation by the Ohm loss is shown to be formulated generally as the state such that yields the minimum dissipation rate of global auto-and/or cross-correlations between two quantities in j, B, and A for their own instantaneous values of the global correlations. (author).

7237 (NIFS–166) **A synergetic treatment of the vortices behaviour of a plasma with viscosity.** Vo Hong Anh; Nguyen Tien Dung. National Inst. for Fusion Science, Nagoya (Japan). Sep 1992. 12p. Order Number DE93754334. Source: OSTI; NTIS; INIS.

The known system of nonlinear partial differential equations (PDE) describing vortical motions of an ideal electron-ion plasma with viscosity in the presence of a slightly inhomogeneous magnetic field is reduced to a Lorentz type system of 3 ordinary differential equations (ODE) the numerical solution of which with a set of a values for real plasma physical parameters shows the occurrence of a state with strange attractors that means the beginning of the vortices formation as an essential nonlinearity effect. (author).

7238 (NIFS-DATA–16) **Atomic processes relevant to polarization plasma spectroscopy.** Fujimoto, T.; Koike, F.; Sakimoto, K.; Okasaka, R.; Kawasaki, K.; Takiyama, K.; Oda, T.; Kato, T. National Inst. for Fusion Science, Nagoya (Japan). Apr 1992. 155p. Order Number DE93753240. Source: OSTI; NTIS; INIS.

When atoms (ions) are excited anisotropically, polarized excited atoms are produced and the radiation emitted by these atoms is polarized. From the standpoint of plasma spectroscopy research, we review the existing data for various atomic processes that are related to the polarization phenomena. These processes are: electron impact excitation, excitation by atomic and ionic collisions, photoexcitation, radiative recombination and bremsstrahlung. Collisional and radiative relaxation processes of atomic polarization follow. Other topics included are: electric-field measurement, self alignment, Lyman doublet intensity ratio, and magnetic-field measurement of the solar prominence. (author).

7239 (PFC/RR–92-13) **Current-drive and plasma-formation experiments on the Versator-II tokamak using lower-hybrid and electron-cyclotron waves.** Colborn, J.A. Massachusetts Inst. of Tech., Cambridge, MA (United States). Plasma Fusion Center. Aug 1992. 235p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-78ET51013. Order Number DE93002333. Source: OSTI; NTIS; INIS; GPO Dep.

During lower-hybrid current-driven (LHCD) tokamak, discharges with thermal electron temperature $T_e \approx 150$ eV, a two-parallel-temperature tail is observed in the electron distribution function. The cold tail extends to parallel energy $E_{||} \approx 4.5$ keV with temperature $T \approx 1.5$ keV, and the hot tail extends to $E_{||} \approx 4.5$ keV with $T > 40$ keV. Fokker-Planck computer simulations suggest the cold tail is created by low power, high $N_{||}$ sidelobes in the lower-hybrid antenna spectrum, and that these sidelobes bridge the "spectral gap," enabling current drive on small tokamaks such as Versator. During plasma-formation experiments using 28 GHz electron-cyclotron (EC) waves, the plasma is born near the EC layer, then moves toward the upper-hybrid (UH) layer within 100–200μs. Wave power is detected in the plasma with frequency f = 300 MHz, indicating the EC waves decay into ion modes and electron Bernstein waves during plasma formation. Measured turbulent plasma fluctuations are correlated with decay-wave amplitude. Toroidal currents up to $I_p \approx 1$ kA are generated, consistent with theory, which predicts asymmetric electron confinement. Electron-cyclotron current-drive (ECCD) is observed with loop voltage $V_{loop} \lesssim 0$ and fully sustained plasma current $I_p \lesssim 15$ kA at densities up to $\langle n_e \rangle = 2 \times 10^{12}$ cm^{-3}. The ECCD efficiency $\eta \equiv \langle n_e \rangle I_p R_0 / P_{rf} = 0.003$, which is 30%–40% of the maximum achievable LHCD efficiency on Versator. The efficiency falls rapidly to zero as the density is raised above $\langle n_e \rangle = 3 \times 10^{12}$ cm^{-3}, suggesting the ECCD depends on low collisionality. X-ray measurements indicate the current is carried primarily by electrons with energies 1 keV $\lesssim E \lesssim$ 10 keV.

7240 (PSC–17) **Elemental compositions of high-energy ions produced by magnetosonic waves in quiescent plasmas.** Toida, M.; Zhang, T.X.; Ohsawa, Y. Nagoya Univ. (Japan). Plasma Science Center. May 1992. 18p. Order Number DE93753241. Source: OSTI; NTIS; INIS.

The structure of a nonlinear magnetosonic wave in a multiple-ion-species plasma is analytically investigated, and the elemental composition of ions reflected by the magnetosonic wave is studied. Firstly, stationary solutions of magnetosonic waves propagating perpendicularly to a magnetic field in a plasma consisting of electrons and two-species ions are obtained from a fluid model. Secondly, on the basis of the solitary wave solution, conditions for ion reflection are discussed. Then, the fraction of high-energy ions produced by a magnetosonic wave is expressed in terms of the ion mass, charge, thermal speed, Alfven speed, and wave amplitude. It rapidly decreases with increasing mass. It is found that most of the light ions can be reflected in a multiple-ion-species plasma even for small-amplitude waves if the masses of the main component ions are sufficiently heavy. (author).

7241 (PSC–18) **Edge plasma control by RF electric field in Compact Helical System (CHS).** Shoji, T. (and others); Sagara, A.; Noda, N. Nagoya Univ. (Japan). Plasma Science Center. May 1992. 19p. Order Number DE93753242. Source: OSTI; NTIS; INIS.

Reducing plasma heat flux on the material limiter and stabilizing fluctuations at the plasma boundary by the use of an RF ponderomotive potential barrier on the limiter (RF limiter) have been demonstrated in Compact Helical System (CHS) for ECH heated plasma. The RF current on a graphite limiter surface along magnetic field lines produces a ponderomotive potential barrier, which is large at the limiter edges. The high heat load on the limiter edges, which is measured using a infrared TV camera, has been shown to be reduced by an RF power of 1.4 kW at the frequency 10 MHz ($\omega_{ci} < \omega << \omega_{ce}$). Another remarkable effect of the ponderomotive potential barrier on the limiter that has been observed is the suppression of density fluctuations (<100 kHz) at the plasma boundary. (author).

7242 (PSC–19) **Large amplitude striations in an RF discharge.** Sato, Teruyuki; Shoji, Tatsuo; Sakawa, Youichi; Hori, Mitsuyoshi. Nagoya Univ. (Japan). Plasma Science Center. May 1992. 14p. Order Number DE93753244. Source: OSTI; NTIS; INIS.

Paired luminous rings separated by a narrow dark-gap are observed in a radio-frequency discharge. In the discharge, a 0.8 - 5 MHz radio-frequency field with an amplitude of ±0.5 - ±1.7 kV is applied to two 100 mm wide electrodes, separated by 20 - 100 mm each other, surrounding a 100 mm diameter pyrex glass tube containing hydrogen gas of 1 - 50 Torr. The number of paired rings, which are axially symmetric with respect to the midplane of two electrodes, increases with the hydrogen gas pressure. The time resolved light intensity measurements show that the outer rings near the electrodes start to appear early in time then the inner rings are produced later. (author).

7243 (PSC–21) **Scaling for effective inductance on RFP dynamo.** Ando, T. (Nagoya Univ. (Japan). Faculty of Engineering); Nagatsu, A.; Tsukisima, T.; Sato, K.I.; Nagata, A.; Arimoto, H. Nagoya Univ. (Japan). Plasma Science Center. Jun 1992. 15p. Order Number DE93753317. Source: OSTI; NTIS; INIS.

A new type of dynamo is found in STP-3M reversed field pinch (RFP). This dynamo generates toroidal flux uniformly along with the toroidal direction. The toroidal flux generated by this dynamo is proportional to the plasma current. It is also found that this relation is satisfied in the other RFP plasmas. The scaling of the effective inductance (proportional constant) obtained by analyzing data of typical RFP plasmas show that the effective inductance is proportional to the minor radius of the plasma. The result indicates that the force free current generates the toroidal flux. (author).

7244 (PSC–23) **Ion ring distribution produced by a magnetosonic wave.** Toida, M.; Zhang, T.X.; Ohsawa, Y. Nagoya Univ. (Japan). Plasma Science Center. Jul 1992. 13p. Order Number DE93754311. Source: OSTI; NTIS; INIS.

Ion orbits reflected by a magnetosonic wave are theoretically analyzed, and the conditions for ion reflection are derived. In a low beta case, those reflected ions can form a ring distribution in the velocity space. The velocity and energy distribution functions of those particles are obtained. (author).

7245 (UCRL-JC–109895) **Simulation models for tokamak plasmas.** Dimits, A.M.; Cohen, B.I. Lawrence Livermore National Lab., CA (United States). 2 Oct 1992. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9206235–4: International Atomic Energy Agency (IAEA) technical committee meeting on advances in simulation and modeling of thermonuclear plasmas, Montreal (Canada), 15 Jun 1992). Order Number DE93002876. Source: OSTI; NTIS; INIS; GPO Dep.

Two developments in the nonlinear simulation of tokamak plasmas are described: (A) Simulation algorithms that use quasiballooning coordinates have been implemented in a 3D fluid code and a 3D partially linearized (Δf) particle code. In quasiballooning coordinates, one of the coordinate directions is closely aligned with that of the magnetic field, allowing both optimal use of the grid resolution for structures highly elongated along the magnetic field as well as implementation of the correct periodicity conditions with no discontinuities in the toroidal direction. (B) Progress on the implementation of a likeparticle collision operator suitable for use in partially linearized particle codes is reported. The binary collision approach is shown to be unusable for this purpose. The algorithm under development is a complete version of the test-particle plus source-field approach that was suggested and partially implemented by Xu and Rosenbluth.

7246 (UCRL-JC–111893) **Multi-fluid modeling of interpenetrating plasmas.** Rambo, P.W.; Denavit, J. Lawrence Livermore National Lab., CA (United States). Sep 1992. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9209268–1: 1992 CECAM workshop, Orsay (France), 7-11 Sep 1992). Order Number DE93002893. Source: OSTI; NTIS; GPO Dep.

One dimensional multi-fluid simulations of interpenetrating plasmas are presented. Separate fluid equations for multiple species are solved with coupling between the different species due to the electric field and Coulomb collisions. These simulations show initial interpenetration followed by stagnation. We present scaling results for colliding plasmas characteristic of opposing, laser heated discs. Simulations of colliding CH plasmas with separate ion fluids for the Carbon and Hydrogen are presented showing appreciable atomic separation. We also show results from hybrid particle and fluid simulations, where particles are used in addition to fluids to represent physical species.

7247 (UCRL-LR–111863) **Poloidal magnetic field profile measurements on the microwave tokamak experiment using far-infrared polarimetry.** Rice, B.W. Lawrence Livermore National Lab., CA (United States). Sep 1992. 239p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93002890. Source: OSTI; NTIS; INIS; GPO Dep.

Thesis submitted to University of California, Davis.

The measurement of plasma poloidal magnetic field (B) profiles in tokamaks with good temporal and spatial resolution has proven to be a difficult but important measurement. A large range of toroidal confinement phenomena is expected to depend sensitively on the radial variation of B including the tearing instability, sawtooth oscillations, disruptions, and transport. Experimental confirmation of theoretical models describing these phenomena has been hampered by the lack of detailed B measurements. A fifteen chord far-infrared (FIR) polarimeter has been developed to measure B in the Microwave Tokamak, Experiment (MTX). Polarimetry utilizes the well known Faraday rotation effect, which causes a rotation of the polarization of an FIR beam propagating in the poloidal plane. The rotation angle is proportional to the component of B parallel to the beam. A new technique for determining the Faraday rotation angle is introduced, based on phase measurements of a rotating polarization ellipse. This instrument has been used successfully to measure B profiles for a wide range of experiments on MTX. For ohmic discharges, measurements of the safety factor on axis give $q_0 \sim 0.75$ during sawteeth and $q_0 > 1$ without sawteeth. Large perturbations to the polarimeter signals correlated with the sawtooth crash are observed during some discharges. Measurements in discharges with electron cyclotron heating (ECH) show a transition from a hollow to peaked J profile that is triggered by the ECH pulse. Current-ramp experiments were done to perturb the J profile from the nominal Spitzer conductivity profile. Profiles for initial current ramps and ramps starting from a stable equilibrium have been measured and are compared with a cylindrical diffusion model. Finally, the tearing mode stability equation is solved using measured J profiles. Stability predictions are in good agreement with the existence of oscillations observed on the magnetic loops.

7248 (UM-P–92/19) **Two fluid plasmas in the vicinity of a Schwarzschild black hole.** Buzzi, V. (Melbourne Univ., Parkville (Australia). School of Physics); Hines, K.C.; Treumann, R.A. Melbourne Univ., Parkville, VIC (Australia). School of Physics. [1992]. [9] Order Number DE93610264. Source: OSTI; NTIS (US Sales Only); INIS.

The 3+1 split of general relativity has been used to investigate the dispersion relation for certain plasma waves, together with the two stream instability, in the vicinity of a Schwarzschild black hole horizon. In contrast to the special relativistic results, the dispersion relations discussed here contain additional terms involving the

gravitational acceleration, a, and the lapse function α. Some of these terms are imaginary and should correspond to gravitational damping effects. 5 refs.

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7249 (CONF-9210173–2) **Approximate methods for generation of covariance data for the structural materials of ENDF/B-VI.** Hetrick, D.M.; Larson, D.C.; Fu, C.Y. Oak Ridge National Lab., TN (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Nuclear Energy Agency Science Committee (NEANSC) specialists meeting on evaluation and processing of covariance data; Oak Ridge, TN (United States); 7-9 Oct 1992. Order Number DE93002343. Source: OSTI; NTIS; INIS; GPO Dep.

The considerations that governed the development of cross section uncertainty files for the isotopes of Cr, Fe, Ni, Cu, and Pb in ENDF/B-VI are summarized. Four different approaches were used in providing the uncertainty information. Illustrative examples are given which show the resulting standard deviations as a function of incident energy and the corresponding correlation matrices.

7250 (DOE/ER–0313/7, pp. 3-5) **Design and fabrication of HFIR-MFE RB* spectrally tailored irradiation capsules.** Longest, A.W. (Oak Ridge National Lab., TN (United States)); Heatherly, D.W.; Corum, J.E. Oak Ridge National Lab., TN (United States). [1989]. In *Fusion reactor materials semiannual progress report for the period ending September 30, 1989.* 315p. Order Number DE90008083. Source: OSTI; NTIS.

Design and fabrication of four HFIR-MFE RB* capsules (60, 200, 330, and 400°C) to accommodate MFE specimens preirradiated in spectrally tailored experiments in the ORR (and associated facility preparations) are proceeding satisfactorily. These capsule designs incorporate provisions for removal, examination, and re-encapsulation of the MFE specimens at an intermediate exposure level of 16 displacements per atom (dpa) en route to a target exposure level of 24 dpa. With the exception of the 60°C capsule, where the test specimens will be in direct contact with the reactor cooling water, the specimen temperatures (monitored by 21 thermocouples) will be controlled by varying the thermal conductance of a small gap region between the specimen holder and the containment tube. Hafnium liners will be used to tailor the neutron spectrum to closely match the helium production-to-atom displacement ratio (14 appm/dpa) expected in a fusion reactor first wall. Assembly of the 60 and 330°C capsules is complete and irradiation of both will begin when the HFIR returns to full power operation. Design of the other two (200 and 400°C) capsules is complete and fabrication of parts is in progress. Assembly of the 200 and 400°C capsules is scheduled for completion by mid-FY 1991; operation of these two capsules will follow the first two (60 and 330°C). Capsule design and preparation of fabrication drawings for re-encapsulation of the MFE specimens after 16 dpa into two dual-temperature capsules (60/200 and 330/400°C) are scheduled to be completed in FY-1990.

7251 (DOE/ER–0313/7, pp. 6-12) **Miniaturized bending fatigue specimen development.** Rao, G.R. (Auburn Univ., AL (United States)); Chin, B.A. Oak Ridge National Lab., TN (United States). [1989]. In *Fusion reactor materials semiannual progress report for the period ending September 30, 1989.* 315p. Order Number DE90008083. Source: OSTI; NTIS.

Two novel miniaturized fatigue specimens were developed for testing candidate first wall/blanket structural materials. The first specimen is termed the 'rectangular' specimen and has dimensions of 30.16 x 4.77 x 0.76 mm with a gauge length of 6.35 mm. The second specimen, termed the 'miniature-disk' specimen, has dimensions based on a transmission electron microscope specimen of 3 mm diameter and 0.3 mm thickness, with a reduced gauge section formed from two 1.5 mm circular radii. Results from the miniature-disk specimen consistently fell above the other data. A good correlation of power law exponents was obtained. The miniature-disk specimen did not show any significant degradation of fatigue properties at elevated temperatures. The rectangular specimen, on the other hand, did show a loss in fatigue life with increasing temperature. Both specimen designs appear to be suitable for testing of candidate first wall/blanket materials for thermal-mechanical fatigue.

7252 (DOE/ER–0313/7, pp. 13-17) **A contamination spot separation method for thickness measurement of irradiated TEM specimens.** Sawai, T. (Oak Ridge National Lab., TN (United States)); Maziasz, P.J.; Suzuki, M.; Hishinuma, A. Oak Ridge National Lab., TN (United States). [1989]. In *Fusion reactor materials semiannual progress report for the period ending September 30, 1989.* 315p. Order Number DE90008083. Source: OSTI; NTIS.

The procedure of obtaining microstructural data from reactor-irradiated specimens has been carefully checked to determine whether swelling data obtained from TEM observations of cavities and density-change data measured using the precision densitometer at the Oak Ridge National Laboratory (ORNL) may be compared accurately. Comparison of data measured by both methods on duplicate or the same specimens has shown some appreciable discrepancies for Japan/U.S. collaborative experiments irradiated in HFIR. The contamination spot separation (CSS) method has been used in the past to determine the thickness of a TEM foil. Recent work has revealed an appreciable error in this method that can overestimate the foil thickness. This error causes lower swelling values to be measured by TEM microstructural observations relative to the precision densitometer. An improved method is proposed for determining the foil thickness by the CSS method, which includes a correction for the overestimation of foil thickness.

7253 (DOE/ER–0313/7, pp. 21-23) **Dosimetry measurements for PNL experiments 12-14 in the Omega West Reactor.** Greenwood, L.R. (Argonne National Lab., IL (United States)). Oak Ridge National Lab., TN (United States). [1989]. In *Fusion reactor materials semiannual progress report for the period ending September 30, 1989.* 315p. Order Number DE90008083. Source: OSTI; NTIS.

Neutron dosimetry measurements and radiation damage calculations are presented for three short irradiations by Battelle Pacific National Laboratory in the Omega West Reactor at Los Alamos National Laboratory. The irradiations occurred between February - April 1988 with a maximum neutron fluence of 8.3×10^{19} n/cm ^{2}.

7254 (DOE/ER–0313/7, pp. 24-26) **Radiation damage for high-temperature superconductors.** Greenwood, L.R. (Argonne National Lab., IL (United States)). Oak Ridge National Lab., TN (United States). [1989]. In *Fusion reactor materials semiannual progress report for the period ending September 30, 1989.* 315p. Order Number DE90008083. Source: OSTI; NTIS.

Calculations have been completed for the production of atomic displacement damage in the new superconducting material $Y_1Ba_2Cu_3O_7$, using the new computer code SPECOMP. New damage cross sections and atomic recoil energy distributions were first calculated for the elements barium and yttrium. The results have been added to the SPECTER computer code for routine calculation of damage in any specified neutron spectrum.

7255 (DOE/ER–0313/7, pp. 33-38) **The morphology of collision cascades as a function of recoil energy.** Heinisch, H.L. (Pacific Northwest Lab., Richland, WA (United States)); Singh, B.N. Oak Ridge National Lab., TN (United States). [1989]. In *Fusion reactor materials semiannual progress report for the period ending September 30, 1989.* 315p. Order Number DE90008083. Source: OSTI; NTIS.

An analytical method based on defect densities has been devised to determine the threshold energies for subcascade formation in computer simulated collision cascades. Cascades generated with the binary collision code MARLOWE in Al, Cu, Ag, Au, Fe, Mo and W were analyzed to determine the threshold energy for subcascade formation, the number of subcascades per recoil per unit energy and the average spacing of subcascades. Compared on the basis of reduced damage energy, metals of the same crystal structure have subcascade thresholds at the same reduced energy. The number of subcascades per unit reduced damage energy is about the same for metals of the same crystal structure, and the average spacing of subcascades is about the same in units of lattice parameters. Comparisons between subcascade threshold energies and

average recoil energies in fission and fusion neutron environments show the spectral sensitivity of the formation of subcascades.

7256 (DOE/ER–0313/7, pp. 39-61) **Implications of neutron spectrum and flux differences on fission-fusion correlations at high neutron fluence.** Garner, F.A. (Pacific Northwest Lab., Richland, WA (United States)); Heinisch, H.L.; Simons, R.L.; Mann, F.M. Oak Ridge National Lab., TN (United States). [1989]. In *Fusion reactor materials semiannual progress report for the period ending September 30, 1989.* 315p. Order Number DE90008083. Source: OSTI; NTIS.

The application to fusion environments of materials data derived from fission reactors involves considerations related not only to neutron spectra but also the often dominant effect of displacement rate. It is shown in this paper that fission-fusion correlation experiments directed toward helium effects and PKA recoil spectra are frequently difficult to interpret due to the strong influence of displacement rate, low energy recoils from thermal neutron absorption, and in some cases a large influence of solid transmutants. It is also shown that materials data published in earlier decades must be reevaluated in light of recent advances in defining irradiation parameters.

7257 (DOE/ER–0313/7, pp. 62-73) **Projected ranges of energetic ions in solids.** Liang, J.H. (Univ. of Wisconsin, Madison (United States)); Kulcinski, G.L. Oak Ridge National Lab., TN (United States). [1989]. In *Fusion reactor materials semiannual progress report for the period ending September 30, 1989.* 315p. Order Number DE90008083. Source: OSTI; NTIS.

Projected range equations, including nuclear and electronic losses up to the third moment, are derived as a simple and accurate means to evaluate projected ranges of energetic ions in solids. With the proposed expressions for the nuclear stopping cross section and the third moment of both nuclear and electronic energy losses, good agreement is observed between the calculated results and experimental data for the projected ranges of ions in both single- and multi-component target materials.

7258 (DOE/ER–0313/7, pp. 74-79) **Relationship between microstructure, spinodal-like decomposition and selective electropolishing of irradiated INVAR-type alloys.** McCarthy, J.M. (Pacific Northwest Lab., Richland, WA (United States)); Garner, F.A. Oak Ridge National Lab., TN (United States). [1989]. In *Fusion reactor materials semiannual progress report for the period ending September 30, 1989.* 315p. Order Number DE90008083. Source: OSTI; NTIS.

EDX analysis and selective electropolishing were used to study two specimens of Fe-35Ni irradiated with neutrons at 420 and 520C and one specimen of Fe-35Ni-15Cr irradiated at 510C. Each was shown to be spinodally decomposed with the period of compositional oscillation appearing to decrease with decreasing irradiation temperature. When polishing conditions are used which promote etching, the low nickel micro-volumes are selectively attacked. The level of chromium appears to play no role in either the selective attack or the period of oscillation. The scale of surface irregularity and that of compositional oscillation appear to be identical but not related to the presence of currently existing microstructural components.

7259 (DOE/ER–0313/7, pp. 80-94) **Theoretical analysis of phase transformations in Fe-Ni 'INVAR'- type alloys.** Russell, K.C. (Massachusetts Inst. of Technology, Cambridge (United States)); Garner, F.A. Oak Ridge National Lab., TN (United States). [1989]. In *Fusion reactor materials semiannual progress report for the period ending September 30, 1989.* 315p. Order Number DE90008083. Source: OSTI; NTIS.

Many studies have suggested that Fe-Ni and Fe-Ni-Cr alloys of ~36 wt % Ni are susceptible to decomposition into two FCC phases. The authors herein model the kinetics and thermodynamics of spinodal decomposition, nucleation, growth, and coarsening of these alloys. Prediction of the scale of a microstructure formed by growth or coarsening may be done with some confidence. The absence of a model for surface energy and gradient energy in systems with negative departure from ideality reduces us to little more than guesses for the kinetics of both nucleation and of spinodal decomposition. They can combine the calculations with those of others and studies of terrestrial and celestial decomposition to reach a conclusion that suggests a miscibility gap for Fe-Ni alloys in the Invar regime. The gap is found to be very narrow at high temperatures but to be broadened at low temperatures by magnetic effects.

7260 (DOE/ER–0313/7, pp. 95-101) **Microstructural investigation of swelling dependence on nickel content in fast-neutron irradiated Fe-Cr-Ni austenitic ternaries.** Muroga, T. (Kyushu Univ. (Japan)); Garner, F.A.; Ohnuki, S. Oak Ridge National Lab., TN (United States). [1989]. In *Fusion reactor materials semiannual progress report for the period ending September 30, 1989.* 315p. Order Number DE90008083. Source: OSTI; NTIS.

Microstructures of Fe-15Cr-XNi (X= 15, 19, 21, 30, 35, 45, 75) ternary alloys and a 15Cr-85Ni binary alloy irradiated in the EBR-II reactor at 510 and 538C to various neutron fluences were examined by TEM. At 510C void nucleation was complete prior to the onset of steady-state swelling at all nickel levels, implying that some process other than void nucleation determines when the relatively rapid void growth associated with the onset of steady-state swelling occurs. The protracted loop dominance of dislocation structure and the relatively low void density at intermediate nickel levels (30-45 wt %) suggested a reduced dislocation bias toward preferential interstitial absorption as a possible mechanism to produce lower swelling in this nickel range.

7261 (DOE/ER–0313/7, pp. 105-113) **Microstructural examination of low activation ferritic alloys irradiated in the FFTF/MOTA to 100 dpa.** Gelles, D.S. (Pacific Northwest Lab., Richland, WA (United States)); Hsu, C.Y. Oak Ridge National Lab., TN (United States). [1989]. In *Fusion reactor materials semiannual progress report for the period ending September 30, 1989.* 315p. Order Number DE90008083. Source: OSTI; NTIS.

The present effort is intended to describe microstructural response to fast neutrons of two tungsten stabilized ferritic/martensitic steels and HT-9 following irradiation to doses as high as 100 dpa. The major change in microstructural development at 420C from 34 to 103 dpa was found to be due to void evolution. No significant differences in dislocation or precipitate structures could be identified, whereas void structures were found to have developed more uniformly and the resultant swelling was greater. The precipitate structure that had formed during irradiation to 34 dpa remained stable to higher dose. Precipitate distributions showed only modest increases in size, indicating that this phase has stabilized, and will not change significantly with further irradiation. Therefore, tungsten stabilized martensitic steels appear to have excellent irradiation resistance, and can be expected to perform well to doses significantly higher than 100 dpa.

7262 (DOE/ER–0313/7, pp. 114-116) **Irradiation creep of the fusion heats of HT9 and 9Cr-1Mo in FFTF/MOTA.** Garner, F.A. (Pacific Northwest Lab., Richland, WA (United States)); Puigh, R.J. Oak Ridge National Lab., TN (United States). [1989]. In *Fusion reactor materials semiannual progress report for the period ending September 30, 1989.* 315p. Order Number DE90008083. Source: OSTI; NTIS.

Steady-state swelling of HT9 and 9Cr-1Mo in FFTF/MOTA appears to develop after 75 dpa for irradiation temperatures in the range 403-410C. The rate of swelling in the stress-free condition is very low, on the order of 0.015%/dpa. Steady-state creep rates also develop concurrently, with creep not only proportional to the applied stress above a certain level but also to the swelling rate. The creep-swelling coupling coefficient for these ferritic/martensitic alloys appears to be very close to that of austenitic alloys. At 520C the creep rate is linear with stress at all stress levels but at 600C these alloys exhibit stress exponents greater than unity, reflecting the onset of thermal creep possibly activated by phase instabilities.

7263 (DOE/ER–0313/7, pp. 117-119) **Microstructural evolution of martensitic steels during fast neutron irradiation.** Maziasz, P.J. (Oak Ridge National Lab., TN (United States)). Oak Ridge National Lab., TN (United States). [1989]. In *Fusion reactor materials semiannual progress report for the period ending September 30, 1989.* 315p. Order Number DE90008083. Source: OSTI; NTIS.

The microstructure of 9Cr-1MoVNb steel evolves quite differently during thermal aging and during neutron irradiation. During thermal aging at temperatures of 482 to 600C for times up to 25,000 h, the as-tempered microstructure of lath/subgrain boundaries and carbides ($M_{23}C_6$ and MC) remains unchanged while films and particles of Laves phase form along grain and subgrain boundaries, and dense dispersions of fine VC needles form in the matrix. By contrast, High Flux Isotope Reactor (HFIR) irradiation at 300 to 500C to 37 to 39 dpa (about 10,000 h) causes the as-tempered subgrain boundary and carbide precipitate structure to become unstable, but does not produce precipitation of any new phases. Irradiation in HFIR causes partial dissolution of $M_{23}C_6$, coarsening and compositional evolution of MC, and recovery and coarsening of the lath/subgrain structure.

7264 (DOE/ER–0313/7, pp. 120-124) **The development of ferritic steels for fast induced-radioactivity decay.** Klueh, R.L. (Oak Ridge National Lab., TN (United States)). Oak Ridge National Lab., TN (United States). [1989]. In *Fusion reactor materials semiannual progress report for the period ending September 30, 1989.* 315p. Order Number DE90008083. Source: OSTI; NTIS.

Irradiation of ferritic steels with neutrons in the temperature range of room temperature to ~450C results in lattice hardening, which causes an increase in strength and a decrease in ductility. Eight reduced-activation Cr-W-V steels with chromium concentrations varying from 2.25 to 12% were irradiated at 365C to ~7 dpa in the Fast Flux Test Facility. Steels containing the combination of 2% W and 0.25% V hardened less than those containing vanadium or tungsten alone or a steel with 1% W and 0.25% V. The amount of hardening was similar for Cr-W-V steels with constant vanadium and tungsten concentrations and containing 2.25, 5 and 9% Cr; a steel with 12% Cr hardened considerably more. Specimens of two conventional Cr-Mo steels, 9Cr-1MoVNb and 12Cr-1MoVW, were also irradiated, and the hardening of these steels was similar to analogous reduced-activation steels.

7265 (DOE/ER–0313/7, pp. 125-130) **Heat treatment effect on impact properties of reduced-activation steels.** Klueh, R.L. (Oak Ridge National Lab., TN (United States)); Maziasz, P.J.; Alexander, D.J. Oak Ridge National Lab., TN (United States). [1989]. In *Fusion reactor materials semiannual progress report for the period ending September 30, 1989.* 315p. Order Number DE90008083. Source: OSTI; NTIS.

The effect of heat treatment on the impact behavior of eight experimental heats of reduced-activation ferritic steels was investigated. Steels with 2 1/4, 5, 9, and 12 wt % Cr and containing tungsten, vanadium, and tantalum were examined. Impact properties of steels with 2 1/4% Cr depended on microstructure, which was affected by cooling rate after austenitization. By heat treating the 2 1/4Cr steels to change the microstructure from a bainitic structure containing ferrite to one without ferrite, the ductile-brittle transition temperatures were reduced substantially. Cooling rate had essentially no effect on the high-chromium martensitic steels.

7266 (DOE/ER–0313/7, pp. 133-139) **Irradiation creep and swelling of annealed type 304L stainless steel at ~390C and high neutron fluence.** Porter, D.L. (Argonne National Lab., IL (United States)); Hudman, G.D.; Garner, F.A. Oak Ridge National Lab., TN (United States). [1989]. In *Fusion reactor materials semiannual progress report for the period ending September 30, 1989.* 315p. Order Number DE90008083. Source: OSTI; NTIS.

The irradiation-induced creep and swelling of AISI 304L in EBR-11 at ~390C have been investigated to exposures on the order of 80 dpa and compared with the behavior of AISI 316 stainless steel. It is shown that swelling and creep of various austenitic steels are strongly interactive phenomena. While swelling depends on stress, displacement rate, composition and cold-work level, the creep rate directly depends only on the stress level and the instantaneous swelling rate. The creep-swelling coupling coefficient does not appear to be very sensitive to composition, cold-work level or temperature.

7267 (DOE/ER–0313/7, pp. 140-144) **Irradiation creep of PCA observed in FFTF/MOTA.** Garner, F.A. (Pacific Northwest Lab., Richland, WA (United States)); Puigh, R.J. Oak Ridge National Lab., TN (United States). [1989]. In *Fusion reactor materials semiannual progress report for the period ending September 30, 1989.* 315p. Order Number DE90008083. Source: OSTI; NTIS.

The candidate austenitic alloy designated PCA was irradiated in FFTF/MOTA in the 20% cold-worked condition to fluences ranging as high as 122 dpa. At temperatures in the range of 384-550C the creep rate was found to be linearly dependent on the applied stress level. The assumption that the B_0 + DS creep model is applicable to this alloy yields a creep-swelling coefficient of $D \simeq 0.6 \times 10^{-2}$ MPa^{-1}, in excellent agreement with the results of studies on solution annealed AISI 304L and various thermomechanical treatments of AISI 316 stainless steel.

7268 (DOE/ER–0313/7, pp. 145-150) **Phase stability of a manganese-stabilized low-activation martensitic steel.** Griffin, R.D. (Univ. of Wisconsin, Madison (United States)); Dodd, R.A.; Kulcinski, G.L.; Gelles, D.S. Oak Ridge National Lab., TN (United States). [1989]. In *Fusion reactor materials semiannual progress report for the period ending September 30, 1989.* 315p. Order Number DE90008083. Source: OSTI; NTIS.

The development of alloys with reduced long-life radioactivity has been incorporated into the goals of fusion materials development. One possible candidate alloy is an Fe-12Cr-6.5Mn-IW-0.3V- 0.1C stabilized martensitic steel. The phase stability of this steel has been investigated following neutron irradiation over a temperature range of 420 to 600C to doses as high as 100 dpa. The microstructural response of the irradiated steel has been compared to that of the same alloy aged for 10,000 h from 365 to 600C. $M_{23}C_6$, was the only carbide found in both the aged and irradiated structures. In the samples aged at 420 and 520C, and the samples irradiated at 520C, an Fe-Cr-Mn-W chi phase formed. In the samples irradiated at 420C, alpha prime formed. The presence of chi phase in both the thermally aged and neutron irradiated steels indicates that the Fe-Cr-Mn system is prone to intermetallic phase formation so that careful study on the effects of alloying are needed.

7269 (DOE/ER–0313/7, pp. 151-154) **Phase stability of an Fe-Cr-Mn alloy aged for 2000 and 5000 hours.** Griffin, R.D. Dodd, R.A. (Univ. of Wisconsin, Madison (United States)); Kulcinski, G.L.; Gelles, D.S. Oak Ridge National Lab., TN (United States). [1989]. In *Fusion reactor materials semiannual progress report for the period ending September 30, 1989.* 315p. Order Number DE90008083. Source: OSTI; NTIS.

An Fe-Cr-Mn-W chi phase formed in a 12Cr-6.5Mn-1W-0.3V-0.1C (wt %) martensitic steel that was aged from 1000 to 5000 h at 420 and 520C. An Fe-25%Cr-15%Mn alloy with a composition close to that of the chi phase was fabricated and aged for 2000 and 5000 h in order to determine phase stability. Optical and transmission electron microscopy of the samples showed that sigma, ferrite, austenite and $M_{23}C_6$ formed. These results show that chi phases does not form easily in simple Fe-Cr-Mn alloys and that chi may require minor additions of tungsten or molybdenum to form thermally.

7270 (DOE/ER–0313/7, pp. 155-159) **Phase stability of Fe-Cr-Mn austenitic steels developed for reduced activation.** Kenik, E.A. (Oak Ridge National Lab., TN (United States)); Maziasz, P.J.; Klueh, R.L. Oak Ridge National Lab., TN (United States). [1989]. In *Fusion reactor materials semiannual progress report for the period ending September 30, 1989.* 315p. Order Number DE90008083. Source: OSTI; NTIS.

The phase stability of manganese-stabilized austenitic alloys based on Fe-12Cr-20Mn-0.25C with minor additions of W, Ti, V, P, and B has been evaluated at 600C. Dominant precipitate phases in both annealed and cold-worked materials are $M_{23}C_6$, and TiC carbides, with no intermetallic phases being observed. Composition differences between matrix and grain boundary $M_{23}C_6$ were observed in aged specimens. Those differences are associated with the formation of grain boundary $M_{23}C_6$ during annealing at high temperature. Minor alloy additions have significant influence on the precipitate structure and composition. Tungsten is strongly incorporated into $M_{23}C_6$ and TiC, whereas vanadium is not. Phosphorus is Incorporated into $M_{23}C_6$, but not into TiC. The austenite stability even after the precipitation of carbides during high temperature annealing indicates that the carbon level of these alloys can be reduced and still maintain a stable austenite matrix with good resistance to intermetallic formation.

7271 (DOE/ER–0313/7, pp. 160-173) **Cavity microstructure and kinetics during GTA welding of helium containing stainless steel.** Lin, H.T. (Auburn Univ., AL (United States)); Chin, B.A.; Grossbeck, M.L.; Goods, S.H. Oak Ridge National Lab., TN (United States). [1989]. In *Fusion reactor materials semiannual progress report for the period ending September 30, 1989.* 315p. Order Number DE90008083. Source: OSTI; NTIS.

Helium was implanted in type 316 stainless steel, through tritium decay, to levels of 0.18, 2.5, 27, 105, and 256 appm. Bead-on-plate welds were then made using the gas tungsten arc process. Intergranular cracking occurred in the heat-affected zones (HAZ) of specimens with helium concentrations equal to or greater than 2.5 appm. No such cracking was observed in helium-free control specimens or in specimens containing the lowest helium concentration. In addition to the HAZ cracking, brittle, centerline cracking occurred in the fusion zone of specimens containing 105 and 256 appm He. Transmission and scanning electron microscopy results indicated that both the HAZ cracking and centerline cracking in the fusion zone resulted from the stress-induced growth and coalescence of cavities initiated at helium bubbles on interfaces. For the HAZ case, the cavity growth rate is modeled and is shown to predict the experimentally measured 1 s time lag between peak weld temperature and the onset of cracking.

7272 (DOE/ER–0313/7, pp. 190-192) **Impact behavior of irradiated V-15Cr-5Ti following hydrogen removal.** Hamilton, M.L. (Pacific Northwest Lab., Richland, WA (United States)); Loomis, B.A. Oak Ridge National Lab., TN (United States). [1989]. In *Fusion reactor materials semiannual progress report for the period ending September 30, 1989.* 315p. Order Number DE90008083. Source: OSTI; NTIS.

Dehydrogenation of V-15Cr-5Ti Charpy impact specimens after irradiation at 400C to 114 dpa was performed prior to impact testing. Hydrogen removal caused no change in the impact behavior of the alloy, yielding a DBTT in excess of 400C.

7273 (DOE/ER–0313/7, pp. 193-202) **A microstructural explanation for irradiation embrittlement of V-15Cr-5Ti.** Gelles, D.S. (Pacific Northwest Lab., Richland, WA (United States)); Garner, F.A.; Ohnuki, S.; Takahashi, H.; Loomis, B.A. Oak Ridge National Lab., TN (United States). [1989]. In *Fusion reactor materials semiannual progress report for the period ending September 30, 1989.* 315p. Order Number DE90008083. Source: OSTI; NTIS.

Recent results have indicated that modest levels of neutron irradiation damage in V-15Cr-5Ti lead to severe degradation of mechanical properties. In order to explain the observed behavior, specimens of V-15Cr-5Ti have been examined by transmission electron microscopy following irradiation at 600C to 14 dpa in the Fast Flux Test Facility (FFTF). The conditions examined included two heats of V-15Cr-5Ti with very different oxygen contents and, in one case, a section of a Charpy specimen demonstrated to have very poor impact resistance. Specimens irradiated at 420 and 520C were also examined to confirm density change measurements that indicated swelling levels as high as 2.5%. Following irradiation at 600C, a complex microstructure was found that included a perfect dislocation network of line segments and loops, faulted loops, a high density of black spot damage and a high density of rod-shaped precipitates. Heat- to-heat variations did not appear to significantly alter these microstructural features; instead the density of large blocky precipitates, believed to be TiO_2, was found to have increased with increasing oxygen content. Only two of the specimens irradiated at 600C contained voids, whereas none of the specimens irradiated at 420 or 520C contained significant void swelling. Therefore, swelling as measured by density change is probably due to phase instability in these specimen conditions, and the hardening and irradiation brittlement that have been observed can be explained by the microstructural development. Phase stability appears to be an important criterion in the design of vanadium alloys for fusion applications.

7274 (DOE/ER–0313/7, pp. 177-189) **Microstructural examination of simple vanadium alloys irradiated in the FFTF/MOTA.** Ohnuki, S. (Hokkaido Univ. (Japan)); Takahashi, H.; Gelles, D.S.; Garner, F.A.; Loomis, B.A. Oak Ridge National Lab., TN (United States). [1989]. In *Fusion reactor materials semiannual progress report for the period ending September 30, 1989.* 315p. Order Number DE90008083. Source: OSTI; NTIS.

A number of simple vanadium alloys have been examined by transmission electron microscopy following irradiation in the Materials Open Test Assembly of the Fast Flux Test Facility (FFTF/MOTA) at 600C to 14 dpa. The alloys included pure vanadium, V-4%Mo, V-9%W, V-10 and V-15%Cr, V-5, 10, and 20%Ti, V-20%Ti-5%Y (in weight percent) and VANSTAR-7. All specimens were found to have developed features typical of radiation damage. However, large differences were found as a function of composition so that void, dislocation and precipitate structures were dissimilar even for specimens of similar composition. For example, different heats of pure vanadium with different interstitial solute contents were examined. One contained voids and the other did not. In a series of three V-Ti alloys, precipitation varied as a function of titanium content. However, in general, specimens displayed precipitate development, often indicated by [001] stacking fault features. About half the alloys contained voids. Dislocation structures included large loops and dislocation tangles but much smaller loops similar to black spot damage could be frequently identified. Therefore, microstructures developed under irradiation are very sensitive to initial composition.

7275 (DOE/ER–0313/7, pp. 203-209) **Tensile properties for neutron-irradiated vanadium alloys.** Loomis, B.A. (Argonne National Lab., IL (United States)); Smith, D.L. Oak Ridge National Lab., TN (United States). [1989]. In *Fusion reactor materials semiannual progress report for the period ending September 30, 1989.* 315p. Order Number DE90008083. Source: OSTI; NTIS.

The tensile properties of V-13.5Cr-5.2Ti, V-9.2Cr-4.9Ti, V-7.2Cr-14.5Ti, V-3.1Ti-0.3Si, and V-17.7Ti alloys were determined after neutron irradiation at 420, 520, and 600C to irradiation damage levels ranging from 21 to 87 dpa. These alloys exhibited a maximum of irradiation hardening in the range of 25 to 50 dpa. These alloys also exhibited significant ductility (>3%) after irradiation at 420, 520, and 600C to 87 dpa.

7276 (DOE/ER–0313/7, pp. 213-219) **Tensile properties and fracture behavior of dispersion strengthened copper alloys irradiated in FFTF-MOTA.** Anderson, K.R. (Univ. of Illinois, Chicago (United States)); Stubbins, J.F.; Garner, F.A.; Hamilton, M.L. Oak Ridge National Lab., TN (United States). [1989]. In *Fusion reactor materials semiannual progress report for the period ending September 30, 1989.* 315p. Order Number DE90008083. Source: OSTI; NTIS.

The objective of this effort is to identify suitable copper alloys for high heat flux applications in fusion reactors. The tensile and fracture behavior of a variety of dispersion strengthened copper alloys were examined after irradiation at 411, 414, and 429C to doses ranging from 32 to 50 dpa. The internally oxidized Glidcop alloys appear to be the best candidates for high heat flux service. Unfortunately, laser welding completely destroys their favorable properties.

7277 (DOE/ER–0313/7, pp. 220-222) **Conductivity changes observed in generation 1.0 copper alloys irradiated at 430C to 16-98 dpa.** Garner, F.A. (Pacific Northwest Lab., Richland, WA (United States)); Anderson, K.R. Oak Ridge National Lab., TN (United States). [1989]. In *Fusion reactor materials semiannual progress report for the period ending September 30, 1989.* 315p. Order Number DE90008083. Source: OSTI; NTIS.

The changes observed in electrical conductivity of pure copper in a variety of neutron irradiation experiments at ~400C are quite consistent. The addition of relatively minor levels of solutes does not appear to change the irradiation response of the alloys beyond the changes observed in the unirradiated condition. The objective of this is effort is to use this data in estimating thermal conductivity changes in high heat flux diverter alloys.

7278 (DOE/ER–0313/7, pp. 223-231) **Density changes of generation 1.5 and 2.0 copper alloys irradiated at 411-414°C and 529°C in FFTF-MOTA.** Garner, F.A. (Pacific Northwest Lab., Richland, WA (United States)); Brager, H.R.; Anderson, K.R. Oak Ridge National Lab., TN (United States). [1989]. In *Fusion reactor materials semiannual progress report for the period ending*

September 30, 1989. 315p. Order Number DE90008083. Source: OSTI; NTIS.

The intrinsic swelling rate of pure copper and Cu-5Ni appears to be ~0.5%/dpa at ~400°C. At 529°C the swelling rate of these alloys appears to be much lower. In more complex precipitation-strengthened alloys, phase instabilities appear to play a role in determining the onset of void swelling and also the density of the unvoided matrix. Dispersion-hardened alloys were found to be very resistant to swelling. Large amounts of oxygen in an alloy, however, can overcome the swelling resistance imparted by very high densities of oxide dispersoids. Internally oxidized Glidcop alloys offer the most pronounced resistance to swelling, with the transient regime progressively extended as alumina content increases. Unfortunately, laser welding destroys the swelling resistance of dispersion-strengthened alloys.

7279 (DOE/ER–0313/7, pp. 235-241) **Evaluation of radiation-induced sensitization of PCA using the electrochemical potentiokinetic reactivation technique.** Inazumi, T. (Oak Ridge National Lab, TN (United States)); Bell, G.E.C. Oak Ridge National Lab., TN (United States). [1989]. In *Fusion reactor materials semiannual progress report for the period ending September 30, 1989.* 315p. Order Number DE90008083. Source: OSTI; NTIS.

The electrochemical potentiokinetic reactivation (EPR) test technique was applied to the determination of sensitization in a neutron-irradiated (420C, 10 dpa) PCA. Miniaturized specimens (3 m diam by 0.25 mm thick) in both solution-annealed and 25% cold-worked conditions were tested and the degree of sensitization (DOS) was calculated in terms of the reactivation charge, Pa. Results indicated the presence of radiation-induced sensitization as compared to control specimens thermally aged at the irradiation temperatures. Post-EPR test examination of the specimen surfaces showed etching across the face of each grain as well as grain boundaries. This indicates that the Pa value normalized by total grain boundary area, which is an accepted EPR-DOS criterion to determine the susceptibility of thermally sensitized stainless steels to intergranular stress corrosion cracking (IGSCC), is not directly applicable to radiation-induced sensitization for the condition investigated. Further investigations are necessary to correlate the results in this study to the IGSCC susceptibility of the irradiated stainless steel.

7280 (DOE/ER–0313/7, pp. 242-249) **Carbon transfer in lithium/structural-material systems.** Hull, A.B. (Argonne National Lab., IL (United States)); Chopra, O.K.; Patel, A.B. Oak Ridge National Lab., TN (United States). [1989]. In *Fusion reactor materials semiannual progress report for the period ending September 30, 1989.* 315p. Order Number DE90008083. Source: OSTI; NTIS.

Chemical interactions involving carbon have a dominant role in the corrosion behavior of ferrous and vanadium-base alloys in lithium. Experimental investigations with these alloys in austenitic forced-circulation lithium loops have shown that weight changes in these systems are influenced by both mass transfer and deposition. The carburization-decarburization behavior of both commercial and high-purity experimental austenitic and ferritic alloys in flowing lithium has been compared with that observed in flowing sodium at temperatures of 550 to 700C. Type 316 stainless steel (SS) and various experimental and commercial heats of Fe-Cr-Mo ferritic materials were investigated to determine the effect of varying levels of chromium and molybdenum. Carbon transfer was evaluated in both pure vanadium and vanadium-base alloys containing various amounts of chromium and titanium, such as V-10Cr-3Fe-Zr, V-15Cr-5Ti, V-10Ti, and V-20Ti.

7281 (DOE/ER–0313/7, pp. 250-254) **Aqueous stress corrosion of structural materials.** Patel, A.B. (Argonne National Lab., IL (United States)); Hull, A.B.; Kassner, T.F. Oak Ridge National Lab., TN (United States). [1989]. In *Fusion reactor materials semiannual progress report for the period ending September 30, 1989.* 315p. Order Number DE90008083. Source: OSTI; NTIS.

The SCC susceptibility of Types 316NG, 316, and 304 stainless steal (SS) has been investigated in slow-strain-rate tests (SSRTs) in aqueous environments that simulate important parameters anticipated for ITER first wall/blanket systems. Initial SSRTs were performed on both crevice and noncrevice specimens in oxygenated water with sulfate additions at a strain rate of 3×10^{-7} s^{-1} and temperatures of 95 and 150C. Scanning electron microscopy showed no evidence of SCC. This was substantiated by an evaluation of the load-carrying capability of identical specimens of Type 316NG SS in air and water. The stress ratio, which is an indicator of cracking susceptibility, was defined as the ratio of the increase in stress after local yielding in the environment to the corresponding stress difference in an identical test in air, both computed at the same strain. A ratio of ~1.0 is indicative of a low SCC susceptibility, which was the situation in the initial experiment on Type 316NG SS at 95C.

7282 (DOE/ER–0313/7, pp. 255-260) **An investigation of the sensitization behavior of Fe-Mn-Cr austenitic steels.** Bell, G.E.C. (Oak Ridge National Lab., TN (United States)); Tortorelli, P.F.; Kenik, E.A. Oak Ridge National Lab., TN (United States). [1989]. In *Fusion reactor materials semiannual progress report for the period ending September 30, 1989.* 315p. Order Number DE90008083. Source: OSTI; NTIS.

Standard chemical immersion (modified Strauss) tests and analytical electron microscopy (AEM) showed that reduced activation austenitic Fe-Mn-Cr steels based on Fe-20Mn-12Cr-0.25C (wt %) are extremely prone to thermal sensitization and resulting intergranular corrosion because of their high carbon contents and low chromium concentrations. Therefore, this susceptibility to sensitization after appropriate thermal aging, fabrication, or irradiation makes their use in aqueous and certain other environments problematical. Excellent correlation between intergranular corrosion induced by immersion in the acidified $CuSO_4$ solution and the presence of narrow chromium-depleted zones around grain boundaries, as determined by AEM, was found. Due to the need to meet reduced activation requirements, the opportunities to increase the sensitization resistance of fully austenitic Fe-Mn-Cr steels by alloy design are limited.

7283 (DOE/ER–0313/7, pp. 263-275) **Irradiation performance of Li_2O and $LiAlO_2$ under large temperature gradients.** Slagle, O.D. (Pacific Northwest Lab., Richland, WA (United States)); Hollenberg, G.W. Oak Ridge National Lab., TN (United States). [1989]. In *Fusion reactor materials semiannual progress report for the period ending September 30, 1989.* 315p. Order Number DE90008083. Source: OSTI; NTIS.

The FUBR-1B irradiation experiment in EBR-II included several large diameter Li_2O and $LiAlO_2$ specimens to simulate the thermal gradients expected in a fusion blanket. These large diameter specimens had center temperatures of 1000 and 1130C in the Li_2O and $LiAlO_2$ pellets, respectively, After irradiation, the Li_2O specimens were reasonably intact but the $LiAlO_2$ specimens had broken into small fragments. The largest diameter Li_2O Pellets (2.4 cm) had increased in diameter during irradiation and had accommodated the center thermal expansion by forming a network of radial cracks. However, the 1.7-cm diameter pellets had decreased in diameter and had accommodated the center thermal expansion by axially extruding the central portion of the pellets. The high temperatures associated with the pellet centers were also found to result in considerable material transport as evidenced by the decrease in center density and the migration of ^6Li from the enriched pellets to the depleted insulator pellets.

7284 (DOE/ER–0313/7, pp. 276-279) **Desorption characteristics of the $LiAlO_2$-H_2O(g) system.** Fischer, A.K. (Argonne National Lab., IL (United States)); Johnson, C.E. Oak Ridge National Lab., TN (United States). [1989]. In *Fusion reactor materials semiannual progress report for the period ending September 30, 1989.* 315p. Order Number DE90008083. Source: OSTI; NTIS.

Temperature programmed desorption (TPD) measurements are in progress to provide data that describe the kinetics of desorption of $H_2O(g)$ and $H_2(g)$ from $LiAlO_2$. Blank experiments (no $LiAlO_2$ present) were performed to gain information on the behavior of the empty stainless steel sample tube exposed to a flowing gas mixture of $H_2O(g)$ and $H_2(g)$. Reactivity with the steel was demonstrated: H_2O is consumed and H_2 is produced, and there is the suggestion of dissolution/reaction of H_2 in the steel. However, in the absence of H_2, it is possible to stabilize the tube so that useful measurements with $H_2O(g)$ can be made. Fresh samples of $LiAlO_2$ contain large amounts of adsorbed H2O. TPD spectra were measured for samples that had been equilibrated with 200 ppm $H_2O(g)$

at temperatures of 200, 300, 400, and 500C. The spectra exhibited different shapes suggestive of differing and/or multiple processes taking place as H_2O is desorbed from the solid.

7285 (DOE/ER–0313/7, pp. 280-283) **Interaction of hydrogen with Li_2O surfaces.** Tam, S.W. (Argonne National Lab., IL (United States)); Johnson, C.E. Oak Ridge National Lab., TN (United States). [1989]. In *Fusion reactor materials semiannual progress report for the period ending September 30, 1989.* 315p. Order Number DE90008083. Source: OSTI; NTIS.

A quantum cluster approach is utilized within the extended Huckel method to investigate the interaction between H_2 and Li_2O (110) surface. Three types of sites have been investigated. It has been found that all three are sites for H_2 non-dissociative adsorption. The binding energetics are around 0.2-0.3 eV and the equilibrium height is around 2 Å. The purpose of this study is to provide reliable and quantitative information to be integrated into a comprehensive tritium release model that has predictive capability and is reliable for the purpose of reactor/blanket design.

7286 (DOE/ER–0313/7, pp. 284-286) **Modeling of tritium behavior in ceramic breeder materials.** Kopasz, J.P. (Argonne National Lab., IL (United States)); Kwasny, J.; Johnson, C.E. Oak Ridge National Lab., TN (United States). [1989]. In *Fusion reactor materials semiannual progress report for the period ending September 30, 1989.* 315p. Order Number DE90008083. Source: OSTI; NTIS.

In-pile tritium release experiments exhibit plateaus In the tritium release at low temperature which are below the tritium generation rate. For Li_2O, these plateaus occur In the temperature region one would expect second-phase precipitation of LiOH/LiOT to occur. Calculations of the tritium pressure in the purge gas for these plateau regions suggest that the tritium release in these regions is not determined by the equilibrium tritium pressure above a diphasic Li_2O-LiOT system.

7287 (DOE/ER–0313/7, pp. 289-296) **Ceramic processing aided by millimeter-wave testing.** Frost, H.M. III (Los Alamos National Lab., NM (United States)); Kennedy, J.C. III; Claytor, T.N.; Brown, E.F.; Zinkle, S.J. Oak Ridge National Lab., TN (United States). [1989]. In *Fusion reactor materials semiannual progress report for the period ending September 30, 1989.* 315p. Order Number DE90008083. Source: OSTI; NTIS.

In a special fusion-neutron irradiation simulation, ^{17}O is being substituted for ^{16}O in 99.5% alumina for raising the potentially deleterious helium gas yield during fission-neutron irradiation up to levels closer to those expected from the fusion neutrons of a deuterium-tritium fusion reaction. For test specimens from two exploratory processing trials at ORNL, done without the expensive ^{17}O enrichment, millimeter-wave (MMW) dielectric data taken at LANL indicated decreases In loss tangent values and in scatter in the dielectric constant values when concentrations of sample defects were apparently reduced. Complementary tensile strength values for enriched specimens correspondingly increased. These data are useful for evaluating potential rf-window performance, but also indicate that dielectric properties correlate with mechanical strength and serve as a sensitive and selective nondestructive measure of general material quality. In some cases, these data can also distinguish between absorption vs. scattering losses and provide estimates of pore sizes. Future dielectric data are planned on enriched alumina specimens - both control and neutron-irradiated.

7288 (DOE/ER–0313/7, pp. 299-304) **Microstructural examination of beryllium irradiated at 400°C to 8 dpa.** Gelles, D.S. (Pacific Northwest Lab., Richland, WA (United States)); Heinisch, H.L. Oak Ridge National Lab., TN (United States). [1989]. In *Fusion reactor materials semiannual progress report for the period ending September 30, 1989.* 315p. Order Number DE90008083. Source: OSTI; NTIS.

Sheet tensile specimens of commercial cast beryllium are found to be brittle following irradiation at 400C to 8 dpa. Failure is by either transgranular brittle fracture or grain boundary embrittlement, depending on specimen thickness. Embrittlement is ascribed both to helium bubble formation at grain boundaries and to c-type loop formation. Loop formation of this type has not previously been reported In the literature.

7289 (DOE/ER–0313/7, pp. 305-311) **Tritium release from irradiated beryllium at elevated temperatures.** Baldwin, D.L. (Pacific Northwest Lab., Richland, WA (United States)); Gelles, D.S.; Slagle, O.D. Oak Ridge National Lab., TN (United States). [1989]. In *Fusion reactor materials semiannual progress report for the period ending September 30, 1989.* 315p. Order Number DE90008083. Source: OSTI; NTIS.

Tritium release kinetics have been measured for neutron-irradiated beryllium in the temperature range of 573-884 K. Two tritium release tests of 270 and 550 h are the first in a series of tritium release tests on irradiated Be in support of the International Thermonuclear Experimental Reactor (ITER) blanket designs. Real-time tritium release curves were measured by an ionization chamber after temperature stop changes of 100 K under tightly controlled conditions specific to ITER. The experimental conditions were designed to measure diffusion-controlled release of tritium from irradiated Be. The preliminary conclusion from this data set is that a unique rate-controlled mechanism is not distinguishable. Apparent diffusion kinetics at lower temperatures give way to a burst release at 884 K, coincident with a restructuring and bubble coalescence in this fully dense material.

7290 (DOE/ER–0313/11, pp. 3-7) **Fabrication of creep and swelling specimens for MOTA-2B irradiation.** Eiholzer, C.R. (Westinghouse Hanford Co., Richland, WA (United States)); Gelles, D.S. Oak Ridge National Lab., TN (United States). Apr 1992. DOE Contract AC06-76RL01830. (ORNL/M–1945). In *Fusion Reactor Materials semiannual progress report for period ending September 30, 1991.* 330p. Order Number DE92014912. Source: OSTI; NTIS; INIS.

The objective of this effort is to determine irradiation creep response in ferritic alloys. The ferritic alloys include three of the most promising low activation alloys and a simple alloy in the same composition range to provide fundamental response. Forty-five pressurized tubes and five open tubes have been made from four ferritic alloys. The alloys include a simple binary alloy, Fe-9Cr, two low activation ferric alloys in the Fe-9Cr range and one low activation alloy in the 11Cr range. Specimens were made for irradiation in the Materials Open Test Assembly (MOTA), starting in cycle 12 of the Fast Flux Test Facility (FFTF), and for corresponding thermal controls. This report documents how the specimens were made and defines the pre-test geometries.

7291 (DOE/ER–0313/11, pp. 8-16) **Effect of MOTA shutdown procedure on radiation-induced microstructural evolution.** Garner, F.A. (Pacific Northwest Lab., Richland, WA (United States)); Ermi, A.M.; Sekimura, N.; Newkirk, J.W. Oak Ridge National Lab., TN (United States). Apr 1992. DOE Contract AC06-76RL01830. (ORNL/M–1945). In *Fusion Reactor Materials semiannual progress report for period ending September 30, 1991.* 330p. Order Number DE92014912. Source: OSTI; NTIS; INIS.

From the standpoint of MOTA operation, reactor scrams are the optimum method of ending an irradiation sequence. However, this procedure induces thermal stresses in core components that shorten their life. Thus, scrams are usually reserved for safety-related considerations only. Of the other shutdown procedures available, one involving helium purging of the MOTA can lead to substantial temperature reductions of the hotter canisters while the reactor is still producing power. At the end of FFTF Cycle 10C, helium purging caused a significant alteration of microstructure at the end of the MOTA 1F experiment. This procedure probably did not alter the total amount of void swelling, but most likely altered the mechanical properties due to additional hardening associated with the formation of a high density of small dislocation loops. In MOTA 1G and MOTA 2A, this purging procedure was not employed and no alteration of microstructure is anticipated.

7292 (DOE/ER–0313/11, pp. 17-29) **Fabrication and operation of HFIR-MFE RB spectrally tailored irradiation capsules.** Longest, A.W. (Oak Ridge National Lab., TN (United States)); Heatherly, D.W.; Clemmer, E.D.; Corum, J.E. Oak Ridge National Lab., TN (United States). Apr 1992. (ORNL/M–1945). In *Fusion Reactor Materials semiannual progress report for period ending September 30, 1991.* 330p. Order Number DE92014912. Source: OSTI; NTIS; INIS.

The objective of this work is to fabricate and operate irradiation capsules for irradiating magnetic fusion energy (MFE) first-wall materials in the High Flux Isotope Reactor (HFIR) removable beryllium (RB) positions. Japanese and US MFE specimens are being transferred to RB positions following irradiation to 7.5 dpa at temperatures of 60, 200, 330, and 400C in Oak Ridge Research Reactor (ORR) experiments ORR-MFE-6J and -7J. Fabrication and operation of four HFIR-MFE RB capsules (60, 200, 330, and 400C) to accommodate MFE specimens previously irradiated in spectrally tailored experiments in the ORR are proceeding satisfactorily. With the exception of the 60C capsule, where the test specimens are in direct contact with the reactor cooling water, the specimen temperatures (monitored by 21 thermocouples) are controlled by varying the thermal conductance of a small gap region between the specimen holder and the containment tube. Irradiation of the 60 and 330C capsules was started on July 17, 1990. As of September 30, 1991, these two capsules had completed 12 cycles of their planned 28-cycle irradiation to a damage level of 20 displacements per atom (dpa). Fabrication of parts for the other two (200 and 400C capsules) is complete. Assembly of the 200 and 400C capsules is scheduled for completion in FY 1993; operation of these two capsules will follow the first two (60 and 330C).

7293 (DOE/ER–0313/11, pp. 30-32) **Fabrication and irradiation of HFIR-MFE-JP-17, -18, and -19 target irradiation capsules.** Longest, A.W. (Oak Ridge National Lab., TN (United States)); Heatherly, D.W.; Wolfe, J.E.; Thoms, K.R.; Corum, J.E. Oak Ridge National Lab., TN (United States). Apr 1992. (ORNL/M–1945). In *Fusion Reactor Materials semiannual progress report for period ending September 30, 1991.* 330p. Order Number DE92014912. Source: OSTI; NTIS; INIS.

The objective of this work is to fabricate and irradiate capsules for testing magnetic fusion energy (MFE) reactor candidate first-wall materials in the High Flux Isotope Reactor (HFIR) target positions. Japanese and US test specimens are being irradiated to determine fracture toughness of austenitic stainless steels and a few chromium ferritic steels and high heat flux alloys after irradiation to 3 dpa at temperatures of 60-125 and 250-300C. Fabrication and irradiation of three new uninstrumented HFIR target capsules for testing 12.5-mm-diameter stainless steel fracture toughness specimens to a damage level of approximately 3 displacements per atom (dpa) at temperatures of 60-125 and 250-300C are proceeding satisfactorily. Two low temperature capsules of identical design, designated HFIR-MFE-JP-18 and HFIR-MFE-JP-19, each contain 32 fracture toughness specimens directly cooled by reactor cooling water. Irradiation of these two capsules is nearing completion. A single helium-filled elevated temperature capsule, designated HFIR-MFE-JP-17, will contain a stack of 86 fracture toughness specimens. Additional neutronic calculations were required for this experiment to insure that it will not cause unacceptable neutron flux shifting and hot spots in HFIR fuel regions. Irradiation of this capsule is scheduled to start in late November, 1991. Included in each capsule are companion transmission electron microscopy (TEM) and SS-3 tensile specimens for correlation of microstructural, tensile, and fracture toughness properties.

7294 (DOE/ER–0313/11, pp. 33-36) **An attempt to reduce radioactivity for energy-dispersive x-ray analysis.** Hamada, S. Oak Ridge National Lab., TN (United States). Apr 1992. (ORNL/M–1945). In *Fusion Reactor Materials semiannual progress report for period ending September 30, 1991.* 330p. Order Number DE92014912. Source: OSTI; NTIS; INIS.

The object of this work is to develop a specimen preparation technique which reduces the intensity of radioactivity of a neutron-irradiated materials for microchemical analysis by analytical electron microscope (AEM) with energy dispersive X-ray spectroscopy (EDXS). A composite specimen preparation technique for the AEM was developed using unirradiated materials. The technique reduced the mass of material from a dummy irradiated specimen by more than a factor of 100. A 1-mm diam. disk was punched from a dummy irradiated 3-mm diam. transmission electron microscope (TEM) disk. The 1-mm disk was then pressed into a hole previously punched at the center of a second 3 mm diam. disk creating a composite disk. The composite disk was electropolished using a twin jet Tenupol until the thickness of the center of the composite was about 100 μm. Approximately 100 μm of nickel plating was then deposited on the surface of the thinned composite. Standard electropolishing by Tenupol unit was performed on the nickel-plated composite specimen and the composite specimen was examined by TEM.

7295 (DOE/ER–0313/11, pp. 39-43) **Helium generation rates in isotopically tailored Fe-Cr-Ni alloys irradiated in FFTF/MOTA.** Greenwood, L.R. (Pacific Northwest Lab., Richland, WA (United States)); Garner, F.A.; Oliver, B.M. Oak Ridge National Lab., TN (United States). Apr 1992. DOE Contract AC06-76RL01830. (ORNL/M–1945). In *Fusion Reactor Materials semiannual progress report for period ending September 30, 1991.* 330p. Order Number DE92014912. Source: OSTI; NTIS; INIS.

The objective of this work is to investigate the effects of the neutron spectrum on mechanical property changes in metals. Three Fe-Cr-Ni alloys have been doped with 0.45 ^{59}Ni for side-by-side irradiations of doped and undoped materials in order to determine the effects of fusion-relevant levels of helium production on microstructural development and mechanical properties. The alloys were irradiated in three successive cycles of the Materials Open Test Assembly (MOTA) located in the Fast Flux Test Facility (FFTF). Following irradiation, helium levels were measured by isotope dilution mass spectrometry. The highest level of helium achieved in doped alloys was 172 appm at 9.1 dpa for a helium(appm)-to-dpa ratio of 18.9. The overall pattern of predicted helium generation rates in doped and undoped alloys is in good agreement with the helium measurements.

7296 (DOE/ER–0313/11, pp. 44-45) **Helium production rates in the LASREF Facility.** Sommer, W.F. (Los Alamos National Lab., NM (United States)); Garner, F.A.; Oliver, B.M. Oak Ridge National Lab., TN (United States). Apr 1992. DOE Contract AC06-76RL01830. (ORNL/M–1945). In *Fusion Reactor Materials semiannual progress report for period ending September 30, 1991.* 330p. Order Number DE92014912. Source: OSTI; NTIS; INIS.

The objective of this study is to determine the helium generation rates produced in the Los Alamos Spallation Radiation Effects Facility (LASREF). Foils of Cu, Co, Fe and Ni were irradiated in LASREF. The flux was determined by measurement of the gamma ray intensities induced by transmutation. The induced helium levels were measured by an isotope dilution mass spectrometry method. For copper the helium/dpa ratio was found to be 11.1 appm/dpa, which is ~405 of the rate predicted by an earlier calculation.

7297 (DOE/ER–0313/11, pp. 46-55) **Neutron activation analysis of monolithic ceramics and ceramic composites.** Snead, L.L. (Oak Ridge National Lab., TN (United States)). Oak Ridge National Lab., TN (United States). Apr 1992. (ORNL/M–1945). In *Fusion Reactor Materials semiannual progress report for period ending September 30, 1991.* 330p. Order Number DE92014912. Source: OSTI; NTIS; INIS.

Several ceramics and ceramic composites of interest for fusion reactors have been irradiated and the isotopes responsible for the induced activity identified. Twenty six isotopes were positively identified and the activity of each measured. The two isotopes which have the combination of highest activity and the longest half life are ^{110m}Ag and ^{60}Co. The possible sources of the impurities are briefly discussed.

7298 (DOE/ER–0313/11, pp. 59-60) **Materials handbook for fusion energy systems.** Davis, J.W. (McDonnell Douglas Missile Systems Co., St Louis, MO (United States)). Oak Ridge National Lab., TN (United States). Apr 1992. (ORNL/M–1945). In *Fusion Reactor Materials semiannual progress report for period ending September 30, 1991.* 330p. Order Number DE92014912. Source: OSTI; NTIS; INIS.

The primary objective is to provide a consistent and authoritative source of material property data for use by the fusion community in the design and analysis of fusion components and systems. The source of this data are contributions from the experimental programs funded by the Fusion Materials programs within D and T. As a result this activity serves as a bridge between the materials experimental programs and the design community by providing the results of fusion researchers in a form readily understood by the

design community. The database effort during this period was directed towards three different program areas: (1) material property support to ITER during the CDA phase; (2) continuation of the Material Handbook for Fusion Energy Systems; and (3) development of the IEA International Fusion Material Handbook.

7299 (DOE/ER–0313/11, pp. 63-71) **The influence of helium on mechanical properties of model austenitic alloys, determined using ^{59}Ni isotopic tailoring and fast reactor irradiation.** Hamilton, M.L. (Pacific Northwest Lab., Richland, WA (United States)); Garner, F.A. Oak Ridge National Lab., TN (United States). Apr 1992. DOE Contract AC06-76RL01830. (ORNL/M–1945). In *Fusion Reactor Materials semiannual progress report for period ending September 30, 1991.* 330p. Order Number DE92014912. Source: OSTI; NTIS; INIS.

The objective of this study is to determine the influence of fusion-relevant helium generation rates on mechanical property changes induced by radiation. Tensile testing on model Fe-Cr-Ni alloys removed from four discharges of the ^{59}Ni isotopic doping experiment in FFTF indicates that helium/dpa ratios typical of fusion reactors do not produce changes in the yield strength or elongation that are significantly different from those at much lower helium generation rates. It also appears that tensile properties approach a saturation level that is dependent only on the final irradiation temperature, but not prior temperature history or thermomechanical starting condition.

7300 (DOE/ER–0313/11, pp. 75-79) **The impact of spectral effects in fast reactors on data analysis and development of fission-fusion correlations.** Greenwood, L.R. (Pacific Northwest Lab., Richland, WA (United States)); Garner, F.A.; Heinisch, H.L. Oak Ridge National Lab., TN (United States). Apr 1992. DOE Contract AC06-76RL01830. (ORNL/M–1945). In *Fusion Reactor Materials semiannual progress report for period ending September 30, 1991.* 330p. Order Number DE92014912. Source: OSTI; NTIS; INIS.

The objective of this study is to examine the influence of neutron spectral differences on correlation of radiation effects data. Models describing the production of freely migrating defects (FMD) during neutron irradiations were applied to materials studies in fast reactors, where neutron spectral effects have been largely ignored. Calculations for the Experimental Breeder Reactor II (EBR-II) and the Fast Flux Test Facility (FFTF) show that effects of spectral differences between in-core and out-of-core positions are significantly larger on the basis of freely migrating defects than on the basis of dpa. As an example, data on swelling behavior measured both in-core and out-of-core in EBR-II show nearly a linear dependence on FMD production but not on dpa.

7301 (DOE/ER–0313/11, pp. 80-87) **Neutron-induced swelling of binary Ni-Al alloys.** Mitchell, M.A. (Univ. of Illinois, Chicago (United States)); Garner, F.A. Oak Ridge National Lab., TN (United States). Apr 1992. DOE Contract AC06-76RL01830. (ORNL/M–1945). In *Fusion Reactor Materials semiannual progress report for period ending September 30, 1991.* 330p. Order Number DE92014912. Source: OSTI; NTIS; INIS.

The objective of this effort is to explore the response to irradiation of materials used in fission-fusion correlation experiments. Five Ni-Al binary alloys with aluminum levels of 1.1, 2.6, 4.2, 7.1 and 13.3 weight percent were irradiated at eight temperatures ranging from 400 to 650C in the EBR-II fast reactor. The density changes induced during irradiation were found to be strongly dependent on both aluminum content and the irradiation temperature. Dynamic solute redistribution caused by radiation-induced segregation and the temperature-dependent formation of γ' phase also appears to contribute significantly to the density changes.

7302 (DOE/ER–0313/11, pp. 88-98) **Phase separation in Fe-35Ni during thermal aging at 625C.** Ji, X. (Washington State Univ., Pullman (United States)); Hoyt, J.J.; Garner, F.A. Oak Ridge National Lab., TN (United States). Apr 1992. DOE Contract AC06-76RL01830. (ORNL/M–1945). In *Fusion Reactor Materials semiannual progress report for period ending September 30, 1991.* 330p. Order Number DE92014912. Source: OSTI; NTIS; INIS.

The objective of this effort is to determine the factors which control the microstructural and microchemical evolution of metals during neutron irradiation. It has been proposed in other studies that the spinodal-like decomposition process observed in some helium effects studies may arise from a radiation-induced self-organization process involving segregation to helium bubbles. In this study phase separation in Fe-35Ni during thermal aging at 625C has been investigated by means of X-ray diffraction, hardness and resistivity measurements. Line broadening of X-ray diffraction peaks demonstrates that this alloy is susceptible to thermal decomposition into two phases. Thus, helium and radiation-induced segregation are not prerequisites for decomposition to occur. However, the absence of appreciable concurrent changes in hardness or resistivity with aging time indicates that the phase separation reaction is very sluggish. Other experiments involving irradiation of Fe-35Ni and various Fe-Cr-35Ni alloys indicate that this phase separation can be accelerated substantially, however. An analysis of existing thermodynamic data has been used to demonstrate that an increased rate of spinodal decomposition can occur for the case of irradiated Fe-35Ni.

7303 (DOE/ER–0313/11, pp. 99-103) **Phosphide formation in neutron-irradiated Fe-15Cr-25Ni-P alloys.** Kinoshita, H. (Hokkaido Univ., Sapporo (Japan)); Garner, F.A. Oak Ridge National Lab., TN (United States). Apr 1992. DOE Contract AC06-76RL01830. (ORNL/M–1945). In *Fusion Reactor Materials semiannual progress report for period ending September 30, 1991.* 330p. Order Number DE92014912. Source: OSTI; NTIS; INIS.

The objective of this study is to provide an understanding of the interactions of phosphorus and cold working on microstructural evolution in neutron irradiated alloys, and thereby assist in the interpretation of this alloy's performance in the ^{59}Ni isotopic tailoring experiment. The results of microstructural examination of irradiation-induced phosphides formed in Fe-15Cr-25Ni-0.055P during the AA-14 experiment agree with trends observed in other studies conducted in both EBR-II and FFTF. The extent of phosphide formation in the annealed condition appears to be a well defined function of both phosphorus level and irradiation temperature. It also appears to be very sensitive to the presence of cold work.

7304 (DOE/ER–0313/11, pp. 104-110) **Silicon's role in determining swelling in neutron-irradiated Fe-Ni-Cr-Si alloys.** Sekimura, N. (Univ. of Toyko (Japan)); Garner, F.A.; Newkirk, J.W. Oak Ridge National Lab., TN (United States). Apr 1992. DOE Contract AC06-76RL01830 ;FG06-89ER75522. (ORNL/M–1945). In *Fusion Reactor Materials semiannual progress report for period ending September 30, 1991.* 330p. Order Number DE92014912. Source: OSTI; NTIS; INIS.

Two silicon-modified alloy series, one based on Fe-15Cr-20Ni and another based on Fe-15Cr-25Ni were irradiated at target temperatures between 399 and 649C in EBR-II. The influence of silicon on swelling is more complex than previously envisioned and indicates that silicon plays two or more competing roles while in solution. Radiation-induced formation of γ' (Ni_3Si) precipitates is dependent on silicon and nickel content, as well as temperature. Precipitation of γ' appears to play only a minor role in void formation.

7305 (DOE/ER–0313/11, pp. 111-125) **Electron irradiation experiments in support of fusion materials development.** Gelles, D.S. (Pacific Northwest Lab., Richland, WA (United States)); Ohnuki, S.; Takahashi, H.; Matsui, H.; Kohno, Y. Oak Ridge National Lab., TN (United States). Apr 1992. DOE Contract AC06-76RL01830. (ORNL/M–1945). In *Fusion Reactor Materials semiannual progress report for period ending September 30, 1991.* 330p. Order Number DE92014912. Source: OSTI; NTIS; INIS.

The objective of this effort is to improve understanding of the effects of fast neutron irradiation on microstructural evolution by examining radiation damage response in a 1 MeV high voltage electron microscope. Microstructural evolution in response to 1 MeV irradiation has been investigated for three simple ferritic alloys, pure beryllium, pure vanadium, and two simple vanadium alloys over a range of temperatures and doses. Microstructural evolution in Fe-3, -9, and -18Cr ferritic alloys is found to consist of crenulated, faulted a<100> loops and circular, unfaulted a/2 <111> loops at low temperatures, but with only unfaulted loops at high temperatures. The complex dislocation evolution is attributed

to sigma phase precipitaults arising from chromium segregation to point defect sinks. Beryllium is found to be resistant to electron damage; the only effect observed was enhanced dislocation mobility. Pure vanadium, V-5Fe, and V-1Ni microstructural response was complicated by precipitation on heating to 400C and above, but dislocation evolution was investigated in the range of room temperature to 300C and at 600C. The three materials behaved similarly, except that pure vanadium showed more rapid dislocation evolution. This difference does not explain the enhanced swelling observed in vanadium alloys.

7306 (DOE/ER–0313/11, pp. 126-140) **Summary of final report on the DOE grant DE-FG03-84ER52110 with UCLA on Radiation Effects on Structural Materials.** Ghoniem, N.M. (Univ. of California, Los Angeles (United States)). Oak Ridge National Lab., TN (United States). Apr 1992. (ORNL/M–1945). In *Fusion Reactor Materials semiannual progress report for period ending September 30, 1991.* 330p. Order Number DE92014912. Source: OSTI; NTIS; INIS.

Research efforts at UCLA on the effects of fusion neutron irradiation on structural materials covered a side range of theoretical and materials engineering problems during the six year period supported by the DOE grant No. DE-FG03-84ER52110. In this brief report, highlights of research accomplishments are presented in the following areas: (1) atomic displacements; (2) microstructure evolution; (3) materials engineering, mechanics and design; (4) invention of low-activation steels; (5) research motivated by grant support.

7307 (DOE/ER–0313/11, pp. 143-151) **Effect of irradiation in HFIR on tensile properties of Cr-Mo steels.** Klueh, R.L. (Oak Ridge National Lab., TN (United States)); Maziasz, P.J. Oak Ridge National Lab., TN (United States). Apr 1992. (ORNL/M–1945). In *Fusion Reactor Materials semiannual progress report for period ending September 30, 1991.* 330p. Order Number DE92014912. Source: OSTI; NTIS; INIS.

An important requirement for a structural material for fusion reactor applications is resistance to irradiation damage by high-energy neutrons. Ferritic steels are highly resistant to void swelling during irradiation in fast reactors and, for that reason are candidate materials for fusion applications. However, in addition to displacement damage caused by the high-energy neutrons (14.1 MeV) produced during the deuterium-tritium fusion reaction, large amounts of transmutation helium will also be generated. Because no adequate source of deuterium-tritium fusion neutrons exists, it is necessary to simulate the effects of such irradiation. In this paper, tensile specimens of tempered martensitic 9Cr-1MoVNb and 12Cr-1MoVW steels with and without additions of 2% Ni were irradiated in the High Flux Isotope Reactor (HFIR) at 400 and 600C to displacement damage levels of up to 72 dpa. Nickel was added to the steels to produce transmutation helium, and up to 700 appm He was produced in the steels with 2% Ni. Irradiation at 400C caused an increase in strength and decrease in ductility, while irradiation at 600C caused a decrease in strength and an increase in ductility. Results at 400C were similar to data from previous tests on steel irradiated to $\approx$ 11 dpa (up to 110 appm He), where it was concluded that helium caused a strength increase in addition to the hardening caused by displacement damage alone. The present results indicate that the helium-enhanced strengthening at 400C saturates with increasing helium concentration, similar to the saturation (at a lower strength level) with displacement-damage dose found in the absence of helium.

7308 (DOE/ER–0313/11, pp. 155-162) **Temperature dependence of the dislocation microstructure of PCA austenitic stainless steel irradiated in ORR spectrally-tailored experiments.** Maziasz, P.J. (Oak Ridge National Lab., TN (United States)). Oak Ridge National Lab., TN (United States). Apr 1992. (ORNL/M–1945). In *Fusion Reactor Materials semiannual progress report for period ending September 30, 1991.* 330p. Order Number DE92014912. Source: OSTI; NTIS; INIS.

Specimens of solution-annealed (SA) and 25% cold-worked (CW) PCA austenitic stainless steel were irradiated in ORR in spectrally-tailored experiments specially designed to produce fusion-relevant He/dpa ratios (12-18 appm He/dpa). SA and CW PCA were irradiated at 330 and 400C to 13 dpa while only CW PCA was irradiated at 60, 200, 330 and 400C to 7.4 dpa. While cavities and fine MC precipitates were only detectable at 330 and 400C, dislocations were a major component of the radiation-induced microstructure at 60-400C. The mixtures of black-dot loops, larger Frank loops, and network that comprised the total dislocation structure were very dependent on irradiation temperature. Both SA and CW PCA contained Frank loops and network dislocations at 330 and 400C. Frank loop concentrations were maximum at 330C and dislocation evolution with dose was most evident at 400C. At 60 and 200C, the microstructure was dominated by very dense dispersions of (1/3 nm diam.) black-dot loops. Some Frank loops were observed at 200C, but almost none were found at 60C. Surprisingly, there was significant radiation-induced recovery of the as-cold-worked dislocation network in CW PCA at all irradiation temperatures. There appears to be a distinguishable transition in the nature of the radiation-induced microstructure between 200 and 330C.

7309 (DOE/ER–0313/11, pp. 163-166) **Low-temperature tensile behavior of irradiated austenitic stainless steels.** Hishinuma, A. (Japan Atomic Energy Research Institute, Ibaraki (Japan)); Jitsukawa, S.; Grossbeck, M.L. Oak Ridge National Lab., TN (United States). Apr 1992. (ORNL/M–1945). In *Fusion Reactor Materials semiannual progress report for period ending September 30, 1991.* 330p. Order Number DE92014912. Source: OSTI; NTIS; INIS.

Low-temperature properties of type 316 austenitic stainless steels, such as mechanical properties and corrosion susceptibility during and after neutron irradiation, are currently a concern in relation to future fusion devices. Type 316 austenitic stainless steel was chosen primarily as the first wall and blanket structural material for the next machines such as the International Thermonuclear Experimental Reactor (ITER). However, there have been few data obtained up to now because of both difficulties of irradiation and lack of interest in such properties at ITER operating conditions, especially at temperatures below 500C. Here, the low-temperature tensile properties of type 316 stainless steel (J316) and Japanese Primary Candidate Alloy (JPCA) irradiated in spectrally tailored Oak Ridge Research Reactor (ORR) and in High Flux Isotope Reactor (HFIR) capsules are summarized. The yield and tensile strengths in the ORR-irradiated specimens were found to increase with increasing irradiation temperatures up to 330C followed by a decrease with increasing temperature. This strength maximum was accompanied by an elongation minimum. Similar trend curves were observed in the HFIR-irradiated specimens, although the temperature of peak strength was shifted higher. The behavior can be understood roughly in terms of microstructural development of dislocation loops and recovery of network dislocations during irradiation. The temperature of peak strength seems to depend on irradiation conditions such as He:dpa ratio and irradiation dose rate.

7310 (DOE/ER–0313/11, pp. 167-172) **The effect of helium on microstructural evolution and mechanical properties of austenitic steels as determined by spectral tailoring experiments.** Sekimura, N. (Univ. of Tokyo (Japan)); Garner, F.A.; Griffin, R.D. Oak Ridge National Lab., TN (United States). Apr 1992. DOE Contract AC06-76RL01830. (ORNL/M–1945). In *Fusion Reactor Materials semiannual progress report for period ending September 30, 1991.* 330p. Order Number DE92014912. Source: OSTI; NTIS; INIS.

The objective of this study is to determine the relative influence of helium generation rate and other important material and environmental variables on neutron-induced microstructural evolution. Fe-15Cr-XNi alloys irradiated at both low (0.66 to 1.2) and very high (27 to 58) helium/dpa levels exhibit significantly different levels of strengthening due to an unprecedented refinement of cavity microstructure at the very high helium levels. When compounded with the nickel dependence of helium generation, the cavity distribution for some irradiation conditions and alloy compositions can be driven below the critical radius for bubble-to-void conversion, leading to a delay in swelling. The critical radius also appears to be dependent on the nickel level. The refinement may not have resulted from the high helium levels alone, however, but also may have been influenced by differences in displacement rate and temperature history in the two experiments.

7311 (DOE/ER–0313/11, pp. 173-180) **The complex role of phosphorus in the neutron-induced swelling of titanium-modified austenitic stainless steels.** Garner, F.A. (Pacific Northwest Lab., Richland, WA (United States)); Mitchell, M.A. Oak Ridge National Lab., TN (United States). Apr 1992. DOE Contract AC06-76RL01830. (ORNL/M–1945). In *Fusion Reactor Materials semiannual progress report for period ending September 30, 1991.* 330p. Order Number DE92014912. Source: OSTI; NTIS; INIS.

The objective of this study is to determine the factors that control the microstructural evolution of structural materials during irradiation. At very low levels (<0.02 wt%), phosphorus additions to austenitic stainless steels often cause a substantial increase in void swelling. This phenomenon occurs in both simple model alloys and more complex solute-modified alloys typical of materials being considered for breeder reactor or fusion reactor service. This effect is observed in both annealed and cold-worked steels. At levels above 0.02% phosphorus, there is a reversal in behavior and swelling declines. This non-monotonic behavior tends to occur at lower irradiation temperatures in relatively simple alloys, but often persists to much higher temperatures in more complex titanium-modified alloys employed in the fusion and breeder reactor programs.

7312 (DOE/ER–0313/11, pp. 181-190) **The strong influence of temper annealing conditions on the neutron-induced swelling of cold worked austenitic steels.** Garner, F.A. (Pacific Northwest Lab., Richland, WA (United States)); Bates, J.F.; Mitchell, M.A. Oak Ridge National Lab., TN (United States). Apr 1992. DOE Contract AC06-76RL01830 ;AC06-76FF02170 ;FG06-89ER75522. (ORNL/M–1945). In *Fusion Reactor Materials semiannual progress report for period ending September 30, 1991.* 330p. Order Number DE92014912. Source: OSTI; NTIS; INIS.

The objective of this study is to define the variables that control the radiation-induced evolution of microstructure and mechanical properties in structural metals. Although cold working is known to strongly influence neutron-induced swelling of austenitic stainless steels. Two irradiation studies conducted on AISI 316 stainless steel indicate that increasing the temperature of the intermediate temper anneal leads in general to a shortening of the transient regime of swelling. The evidence is consistent with the influence of both annealing temperature and irradiation temperature on carbide formation and its subsequent influence on the microchemical evolution and swelling of the steel.

7313 (DOE/ER–0313/11, pp. 191-203) **Irradiation creep and creep rupture of titanium-modified austenitic stainless steels and their dependence on cold work level.** Garner, F.A. (Pacific Northwest Lab., Richland, WA (United States)); Hamilton, M.L.; Eiholzer, C.R.; Toloczko, M.B.; Kumar, A.S. Oak Ridge National Lab., TN (United States). Apr 1992. DOE Contract AC06-76RL01830. (ORNL/M–1945). In *Fusion Reactor Materials semiannual progress report for period ending September 30, 1991.* 330p. Order Number DE92014912. Source: OSTI; NTIS; INIS.

The development of austenitic steels for fusion or breeder reactor service requires choosing not only the optimum composition but also the optimum processing history. Stainless steels are usually specified to be in the cold worked condition, both to provide sufficient strength and to resist void swelling. Cold working to progressively higher levels is known to lead to a continuous but diminishing reduction in swelling. Since the irradiation creep rate is known to be proportional to the concurrent swelling rate, it appears reasonable to assume that the creep rate should also be reduced at higher cold work levels. Here, a titanium-modified austenitic type stainless steel was tested at three cold work levels to determine its creep and creep rupture properties under both thermal aging and neutron irradiation conditions. Both the thermal and irradiation creep behavior exhibit a complex non-monotonic relationship with cold work level that reflects the competition between a number of stress-sensitive and temperature-dependent microstructural processes. Increasing the degree of cold work to 30% from the conventional 20% level was detrimental to its performance, especially for applications above 550C. The 20% cold work level is preferable to the 10% level, in terms of both in-reactor creep rupture response and initial strength.

7314 (DOE/ER–0313/11, pp. 204-211) **Determination of the creep compliance and creep swelling coupling coefficient for neutron irradiated titanium-modified stainless steels at ~ 400C.** Toloczko, M.B. (Univ. of California, Berkeley (United States)); Garner, F.A.; Eiholzer, C.R. Oak Ridge National Lab., TN (United States). Apr 1992. DOE Contract AC06-76RL01830. (ORNL/M–1945). In *Fusion Reactor Materials semiannual progress report for period ending September 30, 1991.* 330p. Order Number DE92014912. Source: OSTI; NTIS; INIS.

The objective of this effort is to provide irradiation creep data and design correlations for application to fusion and breeder reactor design. Irradiation creep data from FFTF-MOTA at ~ 400C were analyzed for nine 20% cold-worked titanium-modified type 316 stainless steels, each of which exhibits a different duration for the transient regime of swelling. One of these steels was the fusion prime candidate alloy designated PCA. The others were various developmental breeder reactor heats. The analysis was based on the assumption that the B_0 + DS creep model applies to these steels at this temperature. This assumption was found to be valid. A creep-swelling coupling coefficient of $D \simeq 0.6 \times 10^{-2}$ MPa^{-1} was found for all steels that had developed a significant level of swelling. This result is in excellent agreement with the results of earlier studies conducted in EBR-II using annealed AISI 304L and also 10% and 20% cold-worked AISI 316 stainless steels. There appears to be some enhancement of swelling by stress, contradicting an important assumption in the analysis and leading to an apparent but misleading nonlinearity of creep with respect to stress.

7315 (DOE/ER–0313/11, pp. 215-226) **Irradiation-induced precipitates in vanadium alloys containing titanium.** Chung, H.M. (Argonne National Lab., IL (United States)); Nowicki, L.J.; Smith, D.L. Oak Ridge National Lab., TN (United States). Apr 1992. (ORNL/M–1945). In *Fusion Reactor Materials semiannual progress report for period ending September 30, 1991.* 330p. Order Number DE92014912. Source: OSTI; NTIS; INIS.

The microstructure, mechanical properties, and density of vanadium-base alloys are profoundly modified during neutron irradiation. The objective of this work is to characterize irradiation-induced precipitation in several candidate vanadium alloys containing titanium after irradiation in the Fast Flux Test Facility Materials Open Test Assembly (FFTF/MOTA) and to correlate the results with the swelling and mechanical properties of the alloys, thereby providing insight for development of an optimized alloy. The microstructures of V-Ti, V-Cr-Ti, and V-Ti-Si alloys were characterized by transmission electron microscopy (TEM) after neutron irradiation in the FFTF at 420 and 600C to fluences up to 114 dpa. Two types of irradiation-induced precipitates were identified, i.e., Ti_2O and $Ti_5(Si,P)_3$. Blocky Ti(O,N,C) precipitates, which form by thermal processes during ingot fabrication, also were observed in all unirradiated and irradiated specimens. Irradiation-induced precipitation of spherical (<15 nm in diameter) $Ti_5(Si,P)_3$ phase was associated with superior resistance to void swelling. In specimens with negligible swelling, $Ti_5(Si,P)_3$ precipitation was significant. Irradiation-induced precipitation of the Ti_2O phase, a phase with needlelike morphology and approximately <20 nm thick and <200 nm long, was more pronounced in high-oxygen specimens irradiated at 600C. It seems that ductility is significantly reduced when the precipitation of Ti_2O and $Ti_5(Si,P)_3$ is pronounced. These observations indicate that initial composition; fabrication processes; actual solute compositions of Ti, O, N, C, P, and Si after fabrication; O, N, and C uptake during service; and irradiation-induced precipitation are interrelated and are important factors to consider in developing an optimized alloy.

7316 (DOE/ER–0313/11, pp. 227-232) **The effect of hydrogen, chromium, titanium, and silicon on the ductile-brittle transition temperature of vanadium and vanadium-base alloys.** Loomis, B.A. (Argonne National Lab., IL (United States)); Nowicki, L.J.; Smith, D.L. Oak Ridge National Lab., TN (United States). Apr 1992. DOE Contract W-31109-ENG-38. (ORNL/M–1945). In *Fusion Reactor Materials semiannual progress report for period ending September 30, 1991.* 330p. Order Number DE92014912. Source: OSTI; NTIS; INIS.

The objective of this research is to determine the composition of a vanadium-base alloy with the optimal combination of mechanical properties, corrosion resistance, fabricability, and weldability for

use as a structural material in the environment of a magnetic fusion reactor. Ductile-brittle transition temperatures (DBTTs) were determined for dehydrogenated and hydrogenated unalloyed V and V-1Ti, V-10Ti, and V-7Cr-5Ti alloys from Charpy-impact tests. These DBTT data complement the data previously reported by Loomis et al. On Charpy impact testing of V-3Ti-1Si, V-5Ti, V-5Cr-5Ti, V-10Cr-5Ti, V-20Ti, V-10Cr-10Ti, V-15Cr-5Ti, V-15Ti-7.5Cr, and Vanstar-7 alloys. The present experimental results show that V alloys with Ti additions (0-20 wt.%) have a minimum DBTT (≈ 250C) in an alloy containing ≈ 5 wt.% Ti, that addition of up to 15 wt.% Cr to V-5Ti alloy results in a substantial increase (90-160C) of the DBTT, and that Si additions (0.25-1.0 wt.%) to V-3Ti alloy result in a significant increase (≈ 60C) in DBTT. In addition, the current results show that the presence of 400-1,200 appm H in unalloyed V and V alloys causes a significant increase (60-250C) in DBTT. The DBTT of V-5Ti, V-5Cr-5Ti,V-7Cr-5Ti, and V-10Ti alloys is least affected by H. The DBTT dependence of these materials on H, Cr, Ti, and Si concentration is presented in the form of tables, graphs, and parametric equations.

7317 (DOE/ER–0313/11, pp. 233-236) **High swelling rates observed in neutron-irradiated V-Cr and V-Si binary alloys.** Garner, F.A. (Pacific Northwest Lab., Richland, WA (United States)); Gelles, D.S.; Takahashi, H.; Ohnuki, S.; Kinoshita, H.; Loomis, B.A. Oak Ridge National Lab., TN (United States). Apr 1992. DOE Contract AC06-76RL01830. (ORNL/M–1945). In *Fusion Reactor Materials semiannual progress report for period ending September 30, 1991.* 330p. Order Number DE92014912. Source: OSTI; NTIS; INIS.

The objective of this effort is to determine the factors which control void swelling in vanadium-base alloys. Additions of 5 to 14 wt% chromium to vanadium led to very large swelling rates during neutron irradiation of the binary alloys, with swelling increasing strongly at higher irradiation temperatures. Addition of 2 wt% silicon to vanadium also leads to very large swelling rates, but swelling decreases with increasing irradiation temperature. Addition of 1 wt% zirconium does not yield high swelling rates, however.

7318 (DOE/ER–0313/11, pp. 239-244) **Irradiation performance of oxide dispersion strengthened copper alloys to 150 dpa at 415C.** Edwards, D.J. (Univ. of Missouri, Columbia (United States)); Kumar, A.S.; Anderson, K.R.; Stubbins, J.F.; Garner, F.A.; Hamilton, M.L. Oak Ridge National Lab., TN (United States). Apr 1992. DOE Contract FG06-89ER75522 ;AC06-76RL01830. (ORNL/M–1945). In *Fusion Reactor Materials semiannual progress report for period ending September 30, 1991.* 330p. Order Number DE92014912. Source: OSTI; NTIS; INIS.

The objective of this effort is to provide design data for use of copper alloys in high heat flux structural applications. Results have been obtained on the post-irradiation properties of various oxide dispersion strengthened copper alloys irradiated from 34 to 150 dpa at 415C in the Fast Flux Test Facility. The GlidCop alloys strengthened by Al_2O_3 continue to outperform other alloys with respect to swelling resistance, and retention of both electrical conductivity and yield strength. Several castable ODS alloys and a Cr_2O_3A HFO_2-strengthened alloy retains most of its strength and its electrical conductivity reaches a constant level after 50 dpa, but it exhibits a higher residual radioactivity.

7319 (DOE/ER–0313/11, pp. 245-249) **The joining of alloys for fusion reactor applications - Brazing of copper-alumina alloys and the weldability of low-activation Fe-Cr-Mn-C steels.** Chin, B.A. (Auburn Univ., Tuscaloosa, AL (United States)); Lee, C.K.; Zinkle, S.J. Oak Ridge National Lab., TN (United States). Apr 1992. (ORNL/M–1945). In *Fusion Reactor Materials semiannual progress report for period ending September 30, 1991.* 330p. Order Number DE92014912. Source: OSTI; NTIS; INIS.

The copper-alumina alloy GLIDCOP Al-15 has been targeted for use in tokamak fusion reactors. This choice was made because of the alloy's ability to retain the cold worked structure after high temperature brazing, coupled with its high heat carrying capacity, and high electrical conductivity. However, the successful use of this alloy depends on the ability to join the alloy during fabrication without destroying these properties. Thus, a brazing process that does not alter the alloy's structure or properties is highly desirable. The objective of this research is the development of an induction brazing process for GLIDCOP Al-15 using a silver brazing alloy. The objective centers on minimizing the time required at elevated temperatures during the brazing process. Induction brazed butt joints were produced from which subsize fatigue samples were fabricated. Some fatigue samples have survived over 2×10^6 cycles in a tension-compression cantilever fatigue mode. The second objective of this study was to characterize the welded microstructure and mechanical properties of two Fe-Cr-Mn-C steels. The effect of gas tungsten arc welding on the microhardness, tensile properties, and ductility of two low-activation Fe-Cr-Mn-C steels was investigated. Sound welds were produced in both steels.

7320 (DOE/ER–0313/11, pp. 253-262) **Slow strain rate tensile testing of fusion spectrally-tailored type 316 material irradiated between 60 and 400C in oxygenated, high-purity water environments.** Bell, G.E.C. (Oak Ridge National Lab., TN (United States)); Tsukada, T.; Shiba, K.; Nakajima, H. Oak Ridge National Lab., TN (United States). Apr 1992. (ORNL/M–1945). In *Fusion Reactor Materials semiannual progress report for period ending September 30, 1991.* 330p. Order Number DE92014912. Source: OSTI; NTIS; INIS.

The objective of this work is to determine the susceptibility of a fusion-relevant alloy to irradiation-assisted stress corrosion cracking (ISACC) by performing slow strain rate tensile (SSRT) testing of fusion spectrally-tailored materials in aqueous environments. Specimens of a type 316 stainless steel (SS) that had been irradiated in the fusion spectrally-tailored MFE-6J/7J experiments in the Oak Ridge Research (ORR) to 7.4 dpa at temperatures of 400, 330, 200, and 60C were SSRT tested in a recirculating autoclave system in oxygenated, high-purity water. Complete intergranular (IG) failure was observed only for the specimen irradiated at 400C. Only 10% IG failure was observed for the 330C irradiated specimen and no IG failure was observed for the specimens irradiated at 200 and 60C.

7321 (DOE/ER–0313/11, pp. 265) **Desorption characteristics of the Li_2O system.** Fischer, A.K. (Argonne National Lab., IL (United States)); Johnson, C.E. Oak Ridge National Lab., TN (United States). Apr 1992. DOE Contract W-31109-ENG-38. (ORNL/M–1945). In *Fusion Reactor Materials semiannual progress report for period ending September 30, 1991.* 330p. Order Number DE92014912. Source: OSTI; NTIS; INIS.

The objective is to describe the energetics and kinetics of desorption of $D_2O(g)$, $HDO(g)$, $H_2O(g)$, HD, and D_2, in the presence and absence of H_2, from the surface of ceramic tritium breeders (Li_2O in the present case) with data that facilitate predictions of the characteristics of tritium release. This reporting period is a time of transition during which temperature programmed desorption (TPD) measurements are being shifted from the $H_2O(g)$-H_2LiAlO_2 system to the D_2-H_2-HD-HDO-Li_2O system.

7322 (DOE/ER–0313/11, pp. 266-267) **Analysis of in-pile tritium release experiments.** Kopasz, J.P.; Tam, S.W.; Johnson, C.E. Oak Ridge National Lab., TN (United States). Apr 1992. DOE Contract W-31109-ENG-38. (ORNL/M–1945). In *Fusion Reactor Materials semiannual progress report for period ending September 30, 1991.* 330p. Order Number DE92014912. Source: OSTI; NTIS; INIS.

The objective of this work is to characterize tritium release behavior from lithium ceramics and develop insight into the underlying tritium release mechanisms. Analysis of tritium release data from recent laboratory experiments with lithium aluminate has identified physical processes which were previously unaccounted for in tritium release models. A new model that incorporates the recent data and provides for release from multiple sites rather than only one site was developed. Calculations of tritium release using this model are in excellent agreement with the tritium release behavior reported for the MOZART experiment.

7323 (DOE/ER–0313/11, pp. 268-270) **Microstructural examination of beryllium irradiated at 500C to 1 dpa.** Gelles, D.S. (Pacific Northwest Lab., Richland, WA (United States)). Oak Ridge National Lab., TN (United States). Apr 1992. DOE Contract AC06-76RL01830. (ORNL/M–1945). In *Fusion Reactor Materials semiannual progress report for period ending September 30, 1991.* 330p. Order Number DE92014912. Source: OSTI; NTIS; INIS.

The objective of this study is to determine the suitability of beryllium as a neutron multiplier for fusion reactor blanket applications. The microstructure of commercial arc cast beryllium has been examined following irradiation in FFTF at 500C to 1 dpa. The major effect of irradiation is the development of helium bubbles on matrix and grain boundary dislocations.

7324 (DOE/ER–0313/11, pp. 273-276) **Anisotropic dislocation loop nucleation in ion-irradiated $MgAl_2O_4$.** Zinkle, S.J. (Oak Ridge National Lab., TN (United States)). Oak Ridge National Lab., TN (United States). Apr 1992. (ORNL/M–1945). In *Fusion Reactor Materials semiannual progress report for period ending September 30, 1991.* 330p. Order Number DE92014912. Source: OSTI; NTIS; INIS.

This work is intended to investigate the effects of transmutation products and varying ionizing-to-displacive damage ratio on microstructural evolution in ceramics for fusion machine. Polycrystalline disks of stoichiometric magnesium aluminate spinel ($MgAl_2O_4$) were irradiated with 2 MeV Al^+ ions at 650C and subsequently analyzed in cross section using transmission electron microscopy (TEM). Interstitial dislocation loops were observed on [110] and [111] habit planes. The population of loops on both sets of habit planes was strongly dependent on their orientation with respect to the ion beam direction. The density of loops with habit plane normals nearly perpendicular to the ion beam direction was much higher than loops with habit plane normals nearly parallel to the ion beam direction. On the other hand, the loop size was nearly independent of habit plane orientation. This anisotropic loop nucleation does not occur in ion-irradiated metals such as copper and may be associated with the structure of displacement cascades in ceramics.

7325 (DOE/ER–0313/11, pp. 277-283) **The effect of displacive and ionizing radiation on the thermal conductivity of Al_2O_3.** White, D.P. (Oak Ridge National Lab., TN (United States)). Oak Ridge National Lab., TN (United States). Apr 1992. (ORNL/M–1945). In *Fusion Reactor Materials semiannual progress report for period ending September 30, 1991.* 330p. Order Number DE92014912. Source: OSTI; NTIS; INIS.

This work is intended to provide information on the changes expected in the thermal conductivity of alumina under irradiation conditions. Recent measurements have shown that the dielectric loss tangent of Al_2O_3 increases dramatically during irradiation by neutrons and protons. This large increase observed during in situ measurements has raised the question as to the effect of radiation on the thermal conductivity under irradiation conditions. The change in the lattice component of the thermal conductivity due to several phonon scattering mechanisms is calculated. The scattering due to intrinsic phonon-phonon interactions, vacancies, and to conduction band electrons is considered. The vacancies produced by displacive radiation strongly scatter phonons in the high frequency portion of the phonon spectrum and the resulting fractional decrease in the thermal conductivity as a function of defect concentration is calculated. Ionizing radiation produces a large increase in the number of electrons in the conduction band and these electrons will scatter phonons in the low frequency portion of the phonon spectrum. The fractional decrease in the thermal conductivity as a function of the radiation induced electrical conductivity is calculated.

7326 (DOE/ER–0313/11, pp. 284-289) **High-temperature mechanical and material design for SiC composites.** Ghoniem, N.M. (Univ. of California, Los Angeles (United States)). Oak Ridge National Lab., TN (United States). Apr 1992. DOE Contract FG03-91ER54115. (ORNL/M–1945). In *Fusion Reactor Materials semiannual progress report for period ending September 30, 1991.* 330p. Order Number DE92014912. Source: OSTI; NTIS; INIS.

Silicon Carbide (SiC) fiber reinforced composites (FRC's) are strong potential candidate structural and high heat flux materials for fusion reactors. During this past decade, they have been vigorously developed for use in aerospace and transportation applications. Recent fusion reactor systems studies, such as ARIES, have concluded that further development of SiC composites will result in significant safety, operational, and waste disposal advantages for fusion systems. A concise discussion of the main material and design issues related to the use of SiC FRC's as structural materials in future fusion systems is given in this paper. The status of material processing of SiC/SiC composites is first reviewed. The advantages and shortcomings of the leading processing technology, known as Chemical Vapor Infiltration are particularly highlighted. A brief outline of the design-relevant physical, mechanical, and radiation data base is then presented. SiC/SiC FRC's possess the advantage of increased apparent toughness under mechanical loading conditions. This increased toughness, however, is associated with the nucleation and propagation of small crack patterns in the structure. Design approaches and failure criteria under these conditions are discussed.

7327 (DOE/ER–0313/11, pp. 290-303) **Composite materials for fusion applications.** Jones, R.H. (Pacific Northwest Lab., Richland, WA (United States)); Henager, C.H. Jr.; Hollenberg, G.W. Oak Ridge National Lab., TN (United States). Apr 1992. DOE Contract AC06-76RL01830. (ORNL/M–1945). In *Fusion Reactor Materials semiannual progress report for period ending September 30, 1991.* 330p. Order Number DE92014912. Source: OSTI; NTIS; INIS.

The purpose of this study is to review the data base on ceramic matrix composites relevant to the critical issues for their application as structural materials in fusion reactors. This report presents a review and analysis of the hermetic, thermal conductivity, corrosion, crack, growth and radiation damage properties of CMCs. It was concluded that the leak rates of a gaseous coolant into the plasma chamber or tritium out of the blanket could exceed design criteria if matrix microcracking causes existing porosity to become interconnected. Thermal conductivities of unirradiated SiC/SiC and C/SiC materials are about 1/2 to 2/3 that of Type 316 SS whereas the thermal conductivity for C/C composites is seven times larger. The thermal stress figure-of-merit value for CMCs exceeds that of Type 316 SS for a single thermal cycle. SiC/SiC composites are very resistant to corrosion and are expected to be compatible with He or Li coolants if the O_2 concentrations are maintained at the appropriate levels. CMCs exhibit subcritical crack growth at elevated temperatures and the crack velocity is a function of the corrosion conditions. The radiation stability of CMCs will depend on the stability of the fiber, microcracking of the matrix, and the effects of gaseous transmutation products on properties.

7328 (DOE/ER–0313/11, pp. 304-308) **Gas leak rate estimates for ceramic matrix composites.** Jones, R.H. (Pacific Northwest Lab., Richland, WA (United States)). Oak Ridge National Lab., TN (United States). Apr 1992. DOE Contract AC06-76RL01830. (ORNL/M–1945). In *Fusion Reactor Materials semiannual progress report for period ending September 30, 1991.* 330p. Order Number DE92014912. Source: OSTI; NTIS; INIS.

The objective of this work is to identify the coolant/plasma boundary-performance limits of ceramic matrix composites used for structural applications. Permeation rates for He through a SiC/SiC composite have been estimated using gas flow equations for viscous and molecular flow through small orifices. The total helium leak rate was determined for a composite material, SiC/SiC, utilized as a pressure boundary between a He coolant and the plasma. The calculated flow rates were determined for the residual porosity resulting from SiC/SiC manufacture and the total first wall surface area. This leak rate was compared to previous estimates of the tolerable leak rate limits established by plasma removal rates and recycling of He in a power reactor. The calculated estimates suggest that the He leak rates are within tolerable limits if the porosity is not interconnected or is interconnected by cracks with openings no larger than 0.3 nm. Increased crack opening, induced by creep or more extensive microcracking induced by radiation or stress, could cause He leak rates to exceed the tolerable limit. These estimates suggest that the use of SiC/SiC composites for structural applications in fusion reactors will require the use of seal coatings if these materials must also perform as a pressure boundary. Similar conclusions should also apply for tritium containment.

7329 (DOE/ER–0313/11, pp. 309-315) **Measurement of the effect of radiation damage to ceramic composite interfacial strength.** Snead, L.L. (Oak Ridge National Lab., TN (United States)); Zinkle, S.J.; Steiner, D. Oak Ridge National Lab., TN (United States). Apr 1992. (ORNL/M–1945). In *Fusion Reactor Materials semiannual progress report for period ending September 30,*

1991. 330p. Order Number DE92014912. Source: OSTI; NTIS; INIS.

The objective of this work is to determine the effects of radiation on the physical and mechanical properties of silicon carbide composite materials. SiC/C/Nicalon Composite materials have been irradiated at 300C in HFIR to a dose of 1 dpa. Three point bend tests demonstrate a marked decrease in ultimate tensile strength while showing added composite toughness. Both strength and toughness changes are shown to be caused by a large decrease in both interfacial shear strength and interfacial friction as measured using a thin section push-out test. The degradation in interfacial properties is attributed to a debonding at the fiber/interface interface due to fiber shrinkage during irradiation.

7330 (DOE/ER–0313/11, pp. 316-322) **Radiation induced microstructure and mechanical property evaluation of SiC/C/SiC composite materials.** Snead, L.L. (Oak Ridge National Lab., TN (United States)); Zinkle, S.J. Oak Ridge National Lab., TN (United States). Apr 1992. (ORNL/M–1945). In *Fusion Reactor Materials semiannual progress report for period ending September 30, 1991*. 330p. Order Number DE92014912. Source: OSTI; NTIS; INIS.

SiC/C/Nicalon composites have been neutron irradiated in both HFIR and FFTF from 1 to 15 dpa and have been ion beam damaged with 3 MeV carbon ions to 30 dpa in a temperature range from room temperature to 900C. The objective of this paper is to present results obtained for radiation induced changes in hardness and modulus and to compare these results with observed microstructural changes.

7331 (DOE/ER–0313/11, pp. 323-326) **In-situ measurement of radiation induced conductivity in ceramics.** Farnum, E.H. (Los Alamos National Lab., NM (United States)); Kennedy, J.M.; Clinard, F.W. Oak Ridge National Lab., TN (United States). Apr 1992. (ORNL/M–1945). In *Fusion Reactor Materials semiannual progress report for period ending September 30, 1991*. 330p. Order Number DE92014912. Source: OSTI; NTIS; INIS.

The objective of this work is to develop a data base and understanding of radiation-induced changes in the electrical properties of ceramic insulators, and then use this information to identify or design new ceramic materials that will improve the performance of magnetic fusion reactors. Changes in the dielectric constant and loss tangent of alumina have been measured in-situ during proton irradiation. In these experiments, single crystal sapphire specimens were irradiated with 3 MeV protons which passed through the sample and were stopped in a copper-block heat sink. Dielectric properties were measured between 100Hz and 10 MHz using a guard ring capacitor configuration. The proton irradiation caused an immediate increase in loss tangent from about 10^{-4} to more than 1.0. The authors have evaluated these changes at 300 K and 373 K, vs irradiation time, flux and frequency. While the in-situ radiation-induced conductivity (RIC) depends on these variables as well as on the history of previous irradiation, they believe that it is caused by a balance between the generation rate of electrons and holes, and their trapping and annihilation at displacement-type defects.

7332 (DOE/ER–0313/12, pp. 3-14) **Preparation and irradiation of fusion MOTA 2B.** Hamilton, M.L. (Pacific Northwest Lab., Richland, WA (United States)); Ermi, R.M.; Ermi, A.M. Oak Ridge National Lab., TN (United States). Jul 1992. In *Fusion Reactor Materials semiannual progress report for the period ending March 31, 1992*. 311p. Order Number DE92019053. Source: OSTI; NTIS; INIS.

The purpose of this effort is to document the loading of the Fusion Materials Open Test Assembly (MOTA 2B) into the Fast Flux Test Facility (FFTF) for irradiation in cycle 12. MOTA 2B was built to support the research and development efforts of three fusion materials programs: the U.S. DOE Neutron Interactive Materials (NIMs) program, the Japanese university fusion materials program, and the IEA-sponsored BEATRIX-II experiments. The MOTA was inserted into the FFTF for irradiation beginning in cycle 12. Irradiation has been completed successfully through cycle 12B.2. Both the specimen loading and the history of cycle 12 to date are documented here.

7333 (DOE/ER–0313/12, pp. 15-23) **Status of U.S./Japan collaborative program phase II HFIR target capsules.** Pawel, J.E. (Oak Ridge National Lab., TN (United States)); Senn, R.L. Oak Ridge National Lab., TN (United States). Jul 1992. In *Fusion Reactor Materials semiannual progress report for the period ending March 31, 1992*. 311p. Order Number DE92019053. Source: OSTI; NTIS; INIS.

The objective of this program is to determine the response of various U.S. Japanese austenitic and ferritic stainless steels with different pretreatments and alloy compositions to the combined effects of displacement damage and helium generation at temperatures in the range of 300 to 600 C and doses of 18 to 70 dpa. A complete description and details of the design, construction, and installation of capsules JP-9 through JP-16 has been previously reported. The capsules were installed in the High Flux Isotope Reactor (HFIR) target July 20, 1990, for irradiation beginning with HFIR fuel cycle 189. The capsules were removed and stored in the reactor pool during HFIR cycle 292 (11/25/90 - 12/10/90) to provide room for required isotope production. They were reinstalled for HFIR cycle 293 for continued irradiation. Of these eight target capsules, JP-10, 11, 13, and 16 completed their scheduled number of cycles (11) and were removed from the reactor in September 1991. These four experiments were successfully disassembled in January 1992. Three new capsules in this series, JP-20, 21, and 22, are presently being designed. These capsules were added to the program in order to complete the experimental matrix included in the JP-9 through 16 capsules. The new capsules will contain transmission electron microscope (TEM) disks and SS-3 flat tensile specimens at 300-600 C and will achieve doses of 8, 18, and 40 dpa, respectively.

7334 (DOE/ER–0313/12, pp. 24-28) **Fabrication and irradiation of HFIR-MFE-JP-17, -18, and -19 irradiation capsules.** Longest, A.W. (Oak Ridge National Lab., TN (United States)); Heatherly, D.W.; Thoms, K.R.; Corum, J.E. Oak Ridge National Lab., TN (United States). Jul 1992. In *Fusion Reactor Materials semiannual progress report for the period ending March 31, 1992*. 311p. Order Number DE92019053. Source: OSTI; NTIS; INIS.

The objective of this work is to fabricate and irradiate capsules for testing magnetic fusion energy (MFE) reactor candidate first-wall materials in the High Flux Isotope Reactor (HFIR) target positions. Fabrication and irradiation of three new uninstrumented HFIR target capsules for testing 12.5-mm-diameter stainless steel fracture toughness specimens to a damage level of approximately 3 displacements per atom (dpa) at temperatures of 60-125 and 250-300 C were completed this report period. Two low temperature capsules of identical design, designated HFIR-MFE-JP-18 and HFIR-MFE-JP-19, each contained 32 fracture toughness specimens directly cooled by reactor cooling water. Irradiation of these two capsules was completed on October 19, 1991. A single helium-filled elevated temperature capsule, designated HFIR-MFE-JP-17, contained a stack of 86 fracture toughness specimen. Additional neutronic calculations were required for this experiment to insure that it would not cause unacceptable neutron flux shifting and hot spots in the HFIR fuel regions. Irradiation of this capsule was completed on February 27, 1992. Included in each capsule were companion transmission electron microscopy (TEM) and SS-3 tensile specimen for correlation of microstructural, tensile, and fracture toughness properties.

7335 (DOE/ER–0313/12, pp. 29-30) **Fabrication and operation of HFIR-MFE-RB spectrally tailored irradiation capsules.** Longest, A.W. (Oak Ridge National Lab., TN (United States)); Heatherly, D.W.; Clemmer, E.D.; Corum, J.E. Oak Ridge National Lab., TN (United States). Jul 1992. In *Fusion Reactor Materials semiannual progress report for the period ending March 31, 1992*. 311p. Order Number DE92019053. Source: OSTI; NTIS; INIS.

The objective of this work is to fabricate and operate irradiation capsules for irradiating magnetic fusion energy (MFE) candidate first-wall materials in the High Flux Isotope Reactor (HFIR) removable beryllium (RB*) positions. Fabrication and operation of four HFIR-MFE RB* capsules (60, 200, 330, and 400 C) to accommodate MFE specimens previously irradiated in spectrally tailored experiments in the ORR are proceeding satisfactorily. With the exception of the 60 C capsule, where the test specimens are in direct

contact with the reactor cooling water, specimen temperatures (monitored by 21 thermocouples) are controlled by varying the thermal conductance of a thin gas gap region between the specimen holder and containment tube. Irradiation of the 60 and 330 C capsules was started on July 17, 1990. As of March 31, 1992, these two capsules had completed 17 cycles of their planned 22-cycle (formerly 28-cycle) irradiation to a damage level of approximately 17.5 displacements per atom (dpa). Assembly of the 200 and 400 C capsules is scheduled for completion in August, 1992; operation of these two capsules will follow the first two (60 and 330 C).

7336 (DOE/ER–0313/12, pp. 31-34) **Status of automated tensile machine.** Satou, M. (Tohoku Univ., Sendai (Japan)); Hamilton, M.L.; Sato, S.; Kohyama, A. Oak Ridge National Lab., TN (United States). Jul 1992. In *Fusion Reactor Materials semiannual progress report for the period ending March 31, 1992.* 311p. Order Number DE92019053. Source: OSTI; NTIS; INIS.

The objective of this work is to develop the Monbusho Automated Tensile machine (MATRON) and install and operate it at the Pacific Northwest Laboratory (PNL). The machine is designed to provide rapid, automated testing of irradiated miniature tensile specimen in a vacuum at elevated temperatures. The MATRON was successfully developed and shipped to PNL for installation in a hot facility. The original installation plan was modified to simplify the current and subsequent installations, and the installation was completed. Detailed procedures governing the operation of the system were written. Testing on irradiated miniature tensile specimen should begin in the near future.

7337 (DOE/ER–0313/12, pp. 35-45) **Fracture toughness measurements with subsize disk compact specimens.** Alexander, D.J. (Oak Ridge National Lab., TN (United States)). Oak Ridge National Lab., TN (United States). Jul 1992. In *Fusion Reactor Materials semiannual progress report for the period ending March 31, 1992.* 311p. Order Number DE92019053. Source: OSTI; NTIS; INIS.

Special fixtures and test methods are necessary to facilitate the fracture toughness testing of small disk compact specimens of irradiated candidate materials for first-wall fusion applications. New methods have been developed for both the unloading compliance and potential drop techniques of monitoring crack growth. Provisions have been made to allow the necessary probes and instrumentation to be installed remotely using manipulators for testing of irradiated specimens in a hot cell. Laboratory trials showed that both unloading compliance and potential drop gave useful results. Both techniques gave similar data, and predicted the final crack extension within allowable limits. The results from the small disk compact specimens were similar to results from conventional compact specimen 12.7 mm thick. However, the slopes of the J-R curves from the larger specimens were lower, suggesting that the smaller disk compact specimens may have lost some constraint due to their size. The testing shows that it should be possible to generate useful J-R curve fracture toughness data from the small disk compact specimens.

7338 (DOE/ER–0313/12, pp. 49-53) **Neutron dosimetry for the MOTA-2A experiment in FFTF.** Greenwood, L.R. (Pacific Northwest Lab., Richland, WA (United States)); Kellogg, L.S. Oak Ridge National Lab., TN (United States). Jul 1992. In *Fusion Reactor Materials semiannual progress report for the period ending March 31, 1992.* 311p. Order Number DE92019053. Source: OSTI; NTIS; INIS.

The objective of this work is to provide dosimetry and damage analysis for fusion materials irradiation experiments in the Materials Open Test Assembly (MOTA). Neutron fluence and spectral measurements and radiation damage calculations are reported for the MOTA-2A experiment in the Fast Flux Test Facility (FFTF). The irradiation was conducted from January 4, 1990 to March 19, 1991 for a total exposure of 299.7 EFPD. The maximum fluence was 15.8×10^{22} n/cm^2, 10.0×10^{22} above 0.1 MeV which produced 43.0 dpa in iron. This MOTA assembly contained the most comprehensive dosimetry to date with thirteen complete spectral measurements and twenty additional flux gradient measurements.

7339 (DOE/ER–0313/12, pp. 54-58) **Calculation of displacement levels for pure elements and most multicomponent alloys irradiated in FFTF MOTA-1F.** Garner, F.A. (Pacific Northwest Lab., Richland, WA (United States)); Greenwood, L.R.; Ermi, A.M. Oak Ridge National Lab., TN (United States). Jul 1992. In *Fusion Reactor Materials semiannual progress report for the period ending March 31, 1992.* 311p. Order Number DE92019053. Source: OSTI; NTIS; INIS.

The number of displacements experienced by a material irradiated in the FFTF depends on the total neutron exposure, the elemental composition, the location in the core, and the specific core employed. This requires that each experimenter determine the displacement levels for all alloys in their experiment and that they be careful to evaluate dpa values consistently when comparing data from different MOTAs or different reactors. Here, a simple method is presented for calculating displacement levels.

7340 (DOE/ER–0313/12, pp. 61-70) **Irradiation behavior of bonded structures: Impact of stress-enhanced swelling on irradiation creep and elastic properties.** Hassan, M.H. (Univ. of Wisconsin, Madison (United States)); Blanchard, J.P.; Kulcinski, G.L. Oak Ridge National Lab., TN (United States). Jul 1992. In *Fusion Reactor Materials semiannual progress report for the period ending March 31, 1992.* 311p. Order Number DE92019053. Source: OSTI; NTIS; INIS.

The objective of this work is to understand the factors that govern the adhesion of coatings on fusion reactor first walls which are subjected to neutron irradiation. Radiation damage will be a major key point in the design of the many duplex components in fusion reactors. There is a substantial amount of available data showing that stress plays a major role in the onset, and possibly the rate, of void growth in austenitic stainless steels. There is also strong support models which predict a coupling of swelling and creep through the stress environment. A parametric study for evidence to stress-enhanced swelling and its connection to creep is conducted for a typical fusion power demonstration reactor. Since microstructural changes are known to affect elastic moduli, the impact of stress enhanced swelling on these moduli are also evaluated.

7341 (DOE/ER–0313/12, pp. 75-80) **Tensile property changes of metals and irradiated to low doses with fission, fusion and spallation neutrons.** Heinisch, H.L. (Pacific Northwest Lab., Richland, WA (United States)); Hamilton, M.L.; Sommer, W.F.; Ferguson, P.D. Oak Ridge National Lab., TN (United States). Jul 1992. In *Fusion Reactor Materials semiannual progress report for the period ending March 31, 1992.* 311p. Order Number DE92019053. Source: OSTI; NTIS; INIS.

The objective of this work is to investigate the effects of the neutron energy spectrum in low dose irradiations on the microstructures and mechanical properties of metals. Radiation effects due to low doses of spallation neutrons are compared directly to those produced by fission and fusion neutrons. Yield stress changes of pure Cu, alumina-dispersion-strengthened Cu and AISI 316 stainless steel irradiated at 36-55 C in the Los Alamos Spallation Radiation Effects Facility (LASREF) are compared with earlier results of irradiations at 90 C using 14 MeV D-T fusion neutrons at the Rotating Target Neutron Source and fission reactor neutrons in the Omega West Reactor. At doses up to 0.04 displacements per atom (dpa), the yield stress changes due to the three quite different neutron spectra correlate well on the basis of dpa in the stainless steel and the Cu alloy. However, in pure Cu, the measured yield stress changes due to spallation neutrons were anomalously small and should be verified by additional irradiations. With the exception of pure Cu, the low dose, low temperature experiments reveal no fundamental differences in radiation hardening by fission, fusion or spallation neutrons when compared on the basis of dpa.

7342 (DOE/ER–0313/12, pp. 81-85) **A comparison of microstructures in copper irradiated with fission, fusion, and spallation neutrons.** Muroga, T. (Kyushu Univ., Fukuoka (Japan)); Heinisch, H.L.; Sommer, W.F.; Ferguson, P.D. Oak Ridge National Lab., TN (United States). Jul 1992. In *Fusion Reactor Materials semiannual progress report for the period ending March 31, 1992.* 311p. Order Number DE92019053. Source: OSTI; NTIS; INIS.

The objective of this work is to investigate the effects of the neutron energy spectrum in low dose irradiations on the microstructure and mechanical properties of metals. The microstructures of pure copper irradiated to low doses at 36-90 C with spallation neutrons,

fusion neutrons and fission neutrons are compared. The defect cluster densities for the spallation and fusion neutrons are very similar when compared on the basis of displacements per atom (dpa). In both cases, the density increases in proportion to the square root of the dpa. The difference in defect density between fusion neutrons and fission neutrons corresponds with differences observed in data on yield stress changes.

7343 (DOE/ER–0313/12, pp. 86-90) **Molecular dynamics and binary collisions modeling of the primary damage state of collision cascades.** Heinisch, H.L. (Pacific Northwest Lab., Richland, WA (United States)); Singh, B.N. Oak Ridge National Lab., TN (United States). Jul 1992. In *Fusion Reactor Materials semiannual progress report for the period ending March 31, 1992.* 311p. Order Number DE92019053. Source: OSTI; NTIS; INIS.

The objective of this work is to determine the spectral dependence of defect production and microstructure evolution for the development of fission-fusion correlations. Quantitative information on defect production in cascades in copper obtained from recent molecular dynamics (MD) simulations is compared to defect production information determined earlier with a model based on the binary collision approximation (BCA). The total numbers of residual defects, the fractions of them that are mobile, and the sizes of immobile clusters compare favorably, especially when the termination conditions of the two simulations are taken into account. A strategy is laid out for integrating the details of the cascade quenching phase determined by MD into a BCA-based model that is practical for simulating much higher energies and longer times than MD alone can achieve. The extraction of collisional phase information from MD simulations and the correspondence of MD and BCA versions of the collisional phase demonstrated at low energy.

7344 (DOE/ER–0313/12, pp. 91-97) **Elemental inhomogeneities developed in stainless steels by radiation-induced segregation.** Kenik, E.A. (Oak Ridge National Lab., TN (United States)). Oak Ridge National Lab., TN (United States). Jul 1992. In *Fusion Reactor Materials semiannual progress report for the period ending March 31, 1992.* 311p. Order Number DE92019053. Source: OSTI; NTIS; INIS.

Radiation-induced segregation (RIS) has been measured by analytical electron microscopy in a number of neutron-irradiated stainless steels stabilized with nickel or manganese. RIS to high angle grain boundaries, cavities, and dislocation loops was observed. Similar enrichment of nickel, silicon, and, in certain cases, phosphorus and depletion of chromium, iron, molybdenum, and manganese occurred at all three of these defect sinks. The origin of matrix composition fluctuations is discussed and an alternate mechanism, based on RIS to the initial dislocation loop microstructure, is suggested.

7345 (DOE/ER–0313/12, pp. 98-103) **A microstructural examination of the mechanical response of FeCrNi alloys irradiated at 365 C using isotope tailoring to produce different He/dpa ratios.** Stubbins, J.F. (Univ. of Illinois, Urbana (United States)); Garner, F.A. Oak Ridge National Lab., TN (United States). Jul 1992. In *Fusion Reactor Materials semiannual progress report for the period ending March 31, 1992.* 311p. Order Number DE92019053. Source: OSTI; NTIS; INIS.

The objective of this effort is to determine the influence of helium on radiation-induced changes in microstructure and mechanical properties of alloys. A series of model Fe-15Cr-xNi-yP alloys with x = 25 or 45 and y = 0.001 or 0.04 wt.% were examined following irradiation to 10.3 dpa at 365 C. These alloys were irradiated both doped and undoped with the ^{59}Ni isotope to produce two levels of helium generation during irradiation. This latter variable produced average He/dpa values of approximately 1 and 16 appm He/dpa in the undoped and doped cases, respectively. Microscopy examination indicates that the major influence of a high He/dpa ratio is to induce a higher void number density and a lower average void size than in identical alloy conditions with low He/dpa. The total swelling is not substantially affected, however. Compositional and thermal mechanical treatment variables were found to influence the swelling behavior as much as the helium production rate. However, in all cases the swelling was low, and irradiation-induction microstructures were similar regardless of starting condition. This convergence in microstructure is reflected in the mechanical properties where similar room temperature tensile properties were measured on irradiated specimens regardless of material starting condition.

7346 (DOE/ER–0313/12, pp. 104-110) **Microstructures of neutron-irradiated Fe-12Cr-XMn (X=15-30) ternary alloys.** Miyahara, K. (Nagoya Univ. (Japan)); Hosoi, Y.; Garner, F.A. Oak Ridge National Lab., TN (United States). Jul 1992. In *Fusion Reactor Materials semiannual progress report for the period ending March 31, 1992.* 311p. Order Number DE92019053. Source: OSTI; NTIS; INIS.

The objective of this effort is to determine the factors which control the stability of irradiated alloys proposed for reduced activation applications. The Fe-Cr-Mn alloy system is being studied as an alternative to the Fe-Cr-Ni system because of the need to reduce long-term radioactivation in fusion-power devices. In this study, four Fe-12Cr-XMn (X =15, 20, 25, 30 wt%) alloys were irradiated in the Fast Flux Test Facility to 20 dpa at 643K and 40 dpa at 679, 793, and 873K to investigate the influence of manganese content on void swelling and phase stability. The results confirm and expand the results of earlier studies that indicate that the Fe-Cr-Mn system is relatively unstable compared to that of the Fe-Cr-Ni system, with alpha and sigma phases forming as a consequence of thermal aging or high temperature irradiation.

7347 (DOE/ER–0313/12, pp. 111-120) **Microstructural evolution of neutron-irradiated Ni-Si and Ni-Al alloys.** Takahashi, H. (Hokkaido Univ., Sapporo (Japan)); Garner, F.A. Oak Ridge National Lab., TN (United States). Jul 1992. In *Fusion Reactor Materials semiannual progress report for the period ending March 31, 1992.* 311p. Order Number DE92019053. Source: OSTI; NTIS; INIS.

The objective of this effort is to provide data on the swelling and segregation response of alloys used in ongoing fission-fusion correlation efforts. Additions of silicon and aluminum suppress the neutron-induced swelling of pure nickel, but to different degrees. Silicon is much more effective initially when compared to aluminum on a per-atom basis, but silicon exhibits a non-monotonic influence on swelling with increasing concentration. Silicon tends to segregate toward grain boundaries while aluminum segregates away from these boundaries. Whereas the formation of the Ni_3Si phase is frequently observed in charged particle irradiation experiments conducted at much higher displacement rates, it did not occur during neutron irradiation in this study. Precipitation also did not occur in Ni-5Al during neutron irradiation, nor has it been reported to occur during ion irradiation.

7348 (DOE/ER–0313/12, pp. 123-130) **Analysis of stress-induced Burgers vector anisotropy in an irradiated ferritic-martensitic steel: JFMS.** Gelles, D.S. (Pacific Northwest Lab., Richland, WA (United States)); Kimura, A.; Kohyama, A.; Puigh, R.J. Oak Ridge National Lab., TN (United States). Jul 1992. In *Fusion Reactor Materials semiannual progress report for the period ending March 31, 1992.* 311p. Order Number DE92019053. Source: OSTI; NTIS; INIS.

The objective of this effort is to improve understanding of the effect of fast neutron irradiation on microstructural evolution by examining the response of neutron irradiated pressurized tubes of a duplex ferritic/martensitic steel. A procedure for determining the Burgers vector anisotropy in irradiated ferritic steels is described, allowing identification of all a < 100 > and all a/2 < 111 > dislocations in a region of interest. The necessary micrographs to apply the procedure have been taken of two pressurized tube specimens of JFMS, a duplex ferritic steel following irradiation in FFTF/MOTA at 407 C to 7.5 x 10^{22} n/cm^2 (E > 0.1 MeV) or 37.5 dpa. Preliminary analysis of one set of micrographs indicates large anisotropy in Burgers vector populations for an 86 MPa stressed condition.

7349 (DOE/ER–0313/12, pp. 131-141) **Ferritic/martensitic steels: Promises and problems.** Klueh, R.L. (Oak Ridge National Lab., TN (United States)); Ehrlich, K.; Abe, F. Oak Ridge National Lab., TN (United States). Jul 1992. In *Fusion Reactor Materials semiannual progress report for the period ending March 31, 1992.* 311p. Order Number DE92019053. Source: OSTI; NTIS; INIS.

Ferritic/martensitic steels are candidate structural materials for fusion reactors because of their higher swelling resistance, higher thermal conductivity, lower thermal expansion, and better liquid-metal compatibility than austenitic steels. Irradiation effects will ultimately determine the applicability of these steels, and the effects of irradiation on microstructure and swelling, and on the tensile, fatigue, and impact properties of the ferritic/martensitic steels are discussed. Most irradiation studies have been carried out in fast reactors, where little transmutation helium forms. Helium has been shown to enhance swelling and affect tensile and fracture behavior, making helium a critical issue, since high helium concentrations will be generated in conjunction with displacement damage in a fusion reactor. These issues are reviewed to evaluate the status of ferritic/martensitic steels and to assess the research required to insure that such steels are viable candidates for fusion applications.

7350 (DOE/ER–0313/12, pp. 145-147) **Interaction of irradiation creep and swelling in the creep disappearance regime.** Garner, F.A. (Pacific Northwest Lab., Richland, WA (United States)); Toloczko, M.B. Oak Ridge National Lab., TN (United States). Jul 1992. In *Fusion Reactor Materials semiannual progress report for the period ending March 31, 1992.* 311p. Order Number DE92019053. Source: OSTI; NTIS; INIS.

The objective of this effort is to determine the relationship between applied stresses and irradiation-induced dimensional changes in structural metals for fusion applications. Reanalysis of an earlier data set derived from irradiation of long creep tubes in EBR-II at 550 C has shown that the creep-swelling coupling coefficient is relatively independent of temperature at $\sim 0.6 \times 10^{-2}$ MPa^{-1}, but falls with increases in the swelling rate, especially at high stress levels. The action of stress-affected swelling and carbide precipitation exert different influences on the derivation of this coefficient.

7351 (DOE/ER–0313/12, pp. 148-162) **Analysis of creep data from MOTA irradiation of 20% cold worked 316 stainless steel.** Garner, F.A. (Pacific Northwest Lab., Richland, WA (United States)); Toloczko, M.B.; Puigh, R.J. Oak Ridge National Lab., TN (United States). Jul 1992. In *Fusion Reactor Materials semiannual progress report for the period ending March 31, 1992.* 311p. Order Number DE92019053. Source: OSTI; NTIS; INIS.

The objective of this study is to provide insight into the relationship between void swelling, irradiation creep and applied stress. This insight will be used to develop irradiation creep correlations for fusion applications. Analysis of creep data for 20% cold worked 316 stainless steel irradiated in FFTF/MOTA demonstrates that creep-swelling coupling coefficient is not a strong function of temperature and can be assumed to be $\sim 0.6 \times 10^{-2}$ MPa^{-1} in the range 400-600 C. It appears, however, that the creep compliance B_o is a moderately strong function of temperature and alloy composition. The latter dependency arises primarily because derived values of B_o unavoidably incorporate precipitation-related strains that cannot be easily separated from contributions arising from true creep. It has also been found that at ~550-600 C there is an upper limit on the total diametral strain rate at 0.33%/dpa. In contrast to the conclusion of an earlier experiment, this limitation does not arise initially from the total disappearance of creep, however. The creep rate first increases with the onset of swelling and then diminishes as the swelling rate increases, disappearing only when the swelling rate reaches its steady state value.

7352 (DOE/ER–0313/12, pp. 163-174) **Void swelling resistance of phosphorus-modified austenitic stainless steels during HFIR irradiation to 57 dpa at 300 to 500 C.** Maziasz, P.J. (Oak Ridge National Lab., TN (United States)). Oak Ridge National Lab., TN (United States). Jul 1992. In *Fusion Reactor Materials semiannual progress report for the period ending March 31, 1992.* 311p. Order Number DE92019053. Source: OSTI; NTIS; INIS.

The objective of this work is to develop advanced austenitic alloys that retain their swelling resistance under irradiation conditions that lead to high helium generation rates. The austenitic stainless steel prime candidate alloy (PCA) is a titanium-modified (14Cr-16Ni) alloy developed for void swelling resistance at 400 to600 C by the U.S. Fusion Reactor Materials (FRM) program. During irradiation in the High Flux Isotope Reactor (HFIR)(20-70 appm He/dpa) at 300 t0 600 C, the PCA (and the closely related D9-type alloy) has been shown to be highly susceptible to void swelling at 500 C after 34 to 57 dpa. Generally such alloys show good void swelling resistance to higher doses during irradiation in fast breeder reactors (FBRs, 0.5-1 appm He/dpa) in the 20 to 25% cold-worked (CW) condition. New multiply stabilized, phosphorus-modifies PCA alloys have been developed, with specific amounts and combinations of minor alloy elements added for better MC formation and stability characteristics during irradiation. After HFIR irradiation at 300 to 500 C to 34 to 57 dpa, the multiply stabilized, phosphorus-modified PCA and phosphorus-modified D9 alloy showed better swelling resistance (by density-change measurements) than similar alloys without phosphorus, particularly at 500 C. Microstructural studies after 34 dpa at 500 C showed that void swelling resistance in the multiply stabilized, phosphorus-modified PCA alloys was directly related to the formation of ultrafine dispersions of MC precipitates during HFIR irradiation.

7353 (DOE/ER–0313/12, pp. 177-184) **Neutron irradiation damage of a stress relieved TZM alloy.** Abe, K. (Tohoku Univ., Sendai (Japan)); Masuyama, T.; Satou, M.; Hamilton, M.L. Oak Ridge National Lab., TN (United States). Jul 1992. In *Fusion Reactor Materials semiannual progress report for the period ending March 31, 1992.* 311p. Order Number DE92019053. Source: OSTI; NTIS; INIS.

The objective of this work is to study defect microstructures and irradiation hardening in a stress relieved TZM alloy after irradiation in the Fast Flux Test Facility (FFTF) using the Materials Open Test Assembly (MOTA). Disk specimens of the molybdenum alloy TZM that had been stress relieved at 1199 K (929 C) for 0.9 ks (15 min.) were irradiated in the FFTF/MOTA 1F at 679, 793 and 873 K (406, 520, and 600 C) to a fast fluence of $\sim 9.6 \times 10^{22}$ n/cm^2. Microstructures were observed in a transmission electron microscope (TEM). Dislocation structures consisted of isolated loops, aggregated loops (rafts) and elongated dislocations. The size of the loops increased with the irradiation temperature. Void swelling was about 1 and 2% at 793 and 873 K (520 and 600 C), respectively. A void lattice was developed in the body centered cubic (bcc) structure with a spacing of 26 - 28 nm. The fine grain size (0.5 - 2 μm) was retained following high temperature irradiation, indicating that the stress relief heat treatment may extend the material's resistance to radiation damage up to high fluence levels. Microhardness measurements indicated that irradiation hardening increased with irradiation temperature. The relationship between the microstructure and the observed hardening was determined.

7354 (DOE/ER–0313/12, pp. 187-191) **Dispersoid stability in a Cu-Al_2O_3 alloy under energetic cascade damage conditions.** Zinkle, S.J. (Oak Ridge National Lab., TN (United States)); Horsewell, A.; Singh, B.N.; Sommer, W.F. Oak Ridge National Lab., TN (United States). Jul 1992. In *Fusion Reactor Materials semiannual progress report for the period ending March 31, 1992.* 311p. Order Number DE92019053. Source: OSTI; NTIS; INIS.

The objective of this study was to examine the stability of small Al_2O_3 particles in dispersion-strengthened copper under highly energetic displacement cascade conditions. A commercial dispersion strengthened Cu-Al_2O_3 alloy was irradiated with 750-MeV protons at 470 K to a damage level of about 2 displacements per atom (dpa). The density and size distribution of the Al_2O_3 particles was measured in nonirradiated and irradiated specimens using transmission electron microscopy. The mean primary knock-on atom (PKA) energy for 750-MeV protons in copper is 2.5 MeV, which is about 10 and 100 times higher than the average PKA energies in copper for fusion and fission neutrons, respectively. The irradiation caused only a slight decreases in the mean Al_2O_3 size, from 10.5 nm to 8.3 nm and a slight decrease in the particle density from 4 $\times 10^{22}/m^3$. These results suggest that Cu-Al_2O_3 alloys, which are resistant to radiation-induced microstructural changes during fission neutron irradiation, may also be microstructurally stable in a fusion neutron environment.

7355 (DOE/ER–0313/12, pp. 192-197) **Fission neutron irradiation of copper containing implanted and transmutation produced helium.** Singh, B.N. (Risoe National Lab., Roskilde (Denmark)); Horsewell, A.; Eldrup, M.; Garner, F.A. Oak Ridge National Lab., TN (United States). Jul 1992. In *Fusion Reactor Materials semiannual progress report for the period ending March 31,*

1992. 311p. Order Number DE92019053. Source: OSTI; NTIS; INIS.

The objective of this effort is to determine the factors which control the radiation-induced evolution of microstructure in copper. High purity copper containing approximately 100 appm helium was produced in two ways. In the first, helium was implanted by cyclotron at Harwell at 323K. In the second method, helium was produced as a transmutation product in 800 MeV proton irradiation at Los Alamos, also at 323K. The distributions of helium prior to fission neutron irradiation were determined by a combination of transmission electron microscopy (TEM) and positron annihilation techniques (PAT). These specimens, together with pure copper, were then irradiated with fission neutrons in a single capsule in Fast Flux Test Facility (FFTF) at ~686± 5K to a dose level of ~48 dpa ($7.7 \times 10^{26} nm^{-2}$; $E > 0.1$ MeV). Investigation of the void and dislocation microstructures in the three specimens by TEM showed large differences between the specimens in void size and swelling. The observed differences as well as the effect of the presence of other transmutation-produced impurity atoms in the 800 MeV proton irradiated copper will be discussed.

7356 (DOE/ER–0313/12, pp. 198-204) **Response of solute and precipitation strengthened copper alloys at high neutron exposure.** Garner, F.A. (Pacific Northwest Lab., Richland, WA (United States)); Hamilton, M.L.; Shikama, T.; Edwards, D.J.; Newkirk, J.W. Oak Ridge National Lab., TN (United States). Jul 1992. In *Fusion Reactor Materials semiannual progress report for the period ending March 31, 1992.* 311p. Order Number DE92019053. Source: OSTI; NTIS; INIS.

The objective of this study is to provide design-relevant data on copper-base alloys for high heat flux applications in fusion reactors. A variety of solute and precipitation strengthened copper base alloys have been irradiated to neutron-induced displacement levels of 34 to 150 dpa at 415 C and 32 dpa at 529 C in the Fast Flux Test Facility to assess their potential for high heat flux applications in fusion reactors. Several MZC-type alloys appear to offer the most promise for further study. For low fluence applications, CuBeNi and spinodally strengthened CuNiTi alloys may also be suitable. Although Cu-2Be resists swelling, it is not recommended for fusion reactor applications because of its low conductivity.

7357 (DOE/ER–0313/12, pp. 205-209) **Tensile and fracture behavior of Cu-5Ni and various precipitation-strengthened copper alloys after high fluence irradiation.** Shikama, T. (Tohoku Univ., Sendai (Japan)); Garner, F.A.; Hamilton, M.L.; Anderson, K.R. Oak Ridge National Lab., TN (United States). Jul 1992. In *Fusion Reactor Materials semiannual progress report for the period ending March 31, 1992.* 311p. Order Number DE92019053. Source: OSTI; NTIS; INIS.

The objective of this effort is to determine the radiation response of copper alloys proposed for fusion service. Tensile tests and fractography were used to examine the radiation induced evolution of Cu-%Ni and three commercially prepared precipitation-strengthened alloys after irradiation at 685 and 800K (411 and 527 C). The addition of nickel to copper resulted in increased ductility prior to irradiation but decreased relative ductility after irradiation. The difference in behavior following irradiation appears to arise from the influence of nickel on void swelling. The precipitation strengthened alloys in general exhibited a drop in yield strength after irradiation and an associated increase in ductility. The major effect in these alloys appeared to be related to overaging of the precipitates.

7358 (DOE/ER–0313/12, pp. 213-224) **Assessment of H-induced crack growth of type 316 SS at ITER conditions.** Jones, R.H. (Pacific Northwest Lab., Richland, WA (United States)). Oak Ridge National Lab., TN (United States). Jul 1992. In *Fusion Reactor Materials semiannual progress report for the period ending March 31, 1992.* 311p. Order Number DE92019053. Source: OSTI; NTIS; INIS.

The results of this analysis suggest that H-induced crack growth of Type 316 SS is a definite concern for ITER first-wall applications. It was estimated that crack velocities as high as 2×10^{-6} m/s could result in Type 316 SS irradiated at 100 C to 10 dpa, while the threshold, K_{th}, for crack growth could be as low as 28 to 37 $MPa\sqrt{m}$ for hydrogen generated by (n,p) reactions. This crack velocity would propagate through a 4-mm-thick first wall in 33 minutes, and therefore these conclusions should be evaluated experimentally. Also, a K_{th} of $28 MPa\sqrt{m}$ requires that the applied and residual stresses in the structure be limited to 500 MPa for a 1-mm-long crack to avoid H-induced crack growth. Higher stress limits are possible for shorter cracks. These predictions are based on the assumption that all the H generated by (n,p) reactions would be contained within the material; however, some loss of H to the vacuum or water side of the first wall is expected. The extent of this loss will depend on engineering considerations such as coatings, etc.

7359 (DOE/ER–0313/12, pp. 225-235) **Aqueous stress corrosion of candidate austenitic steels for ITER structural applications.** Hull, A.B. (Argonne National Lab., IL (United States)); Luebbers, P.R.; Fox, M.R.; Soppet, W.K.; Kassner, T.F. Oak Ridge National Lab., TN (United States). Jul 1992. In *Fusion Reactor Materials semiannual progress report for the period ending March 31, 1992.* 311p. Order Number DE92019053. Source: OSTI; NTIS; INIS.

The corrosion resistance of the structural material to be used in an aqueous environment characteristic of candidate first-wall/blanket systems in the International Thermonuclear Experimental Reactor (ITER) has never been quantified. Information on the stress corrosion cracking (SCC) susceptibility of several candidate stainless steels under ITER-relevant conditions will help to identify an optimal combination of structural materials, coolant chemistry, and operational conditions for ongoing ITER design work. The objective of the task described in this report is to provide baseline information on SCC susceptibility of candidate stainless steels in high-purity oxygenated water that simulates many important parameters anticipated in ITER first-wall/blanket systems. SCC tests will also be conducted under off-normal water chemistry conditions and at higher temperatures to establish the performance limits of the materials. Susceptibility of Types 316NG and sensitized 304 stainless steels (SS) to SCC was investigated at temperatures of 60-289 C in slow-strain-rate-tensile (SSRT) tests in oxygenated water that simulates important parameters anticipated in first-wall/blanket systems. Type 316NG SS exhibits good resistance to SCC under crevice and noncrevice conditions at temperatures <150 C in nominal ITER coolant chemistry that does not contain any short-lived radical species from radiolysis of water. Initial SSRT tests have been conducted on weldment specimens of Type 316NG SS with matching filler metal under crevice and noncrevice conditions in oxygenated water at 95 C. These specimens fractured in the base metal rather than in the weld or hear-affected zones.

7360 (DOE/ER–0313/12, pp. 236-243) **Characterization of radiation-induced segregation in austenitic stainless steels using analytical electron microscopy and scanning Auger microprobe techniques.** Bell, G.E.C. (Oak Ridge National Lab., TN (United States)); Kenik, E.A.; Heatherly, L. Jr. Oak Ridge National Lab., TN (United States). Jul 1992. In *Fusion Reactor Materials semiannual progress report for the period ending March 31, 1992.* 311p. Order Number DE92019053. Source: OSTI; NTIS; INIS.

In this work, the authors characterized radiation-induced grain-boundary segregation of commercial-purity (CP) and high-purity (HP) type 304 SS irradiated in a fission power reactor at 288 C to 2×10^{21} n/cm^2 ($E > 1$ MeV) or about 1 dpa using both high-resolution AEM and Auger electron spectroscopy (AES). Both AEM and AES showed strong nickel and silicon enrichment along with moderate chromium depletion at grain boundaries in the CP material. No statistically significant minor element segregation was measurable with either AEM or AES. Good agreement between AEM segregation profiles measured perpendicular to grain boundaries and AES sputter-depth profile results is obtained.

7361 (DOE/ER–0313/12, pp. 244-249) **Electrochemical and microstructural characterization of an austenitic stainless steel irradiation by heavy ions above 600 C.** Ball, G.E.C. (Oak Ridge National Lab., TN (United States)); Kenik, E.A.; Inazumi, T. Oak Ridge National Lab., TN (United States). Jul 1992. In *Fusion Reactor Materials semiannual progress report for the period ending March 31, 1992.* 311p. Order Number DE92019053. Source: OSTI; NTIS; INIS.

The electrochemical behavior and microstructural evolution of a solution-annealed, heavy-ion-irradiated, austenitic stainless steel

(SS) have been investigated at temperatures above 600 C at doses of 1, 10, and 70 displacements per atom (dpa) with concurrent helium injection of 0.2 atomic parts per million He per dpa (appm-He/dpa). Changes in the electrochemical properties were measured by the single-loop electrochemical potentiokinetic reactivation (SL-EPR) technique using transmission electron microscopy (TEM) disk specimens. Microchemical analysis has also been performed on some duplicate specimens in an AEM. Electrochemical results showed that the reactivation charge per unit etched area and Flade potential increased with increasing dose. In the case of the 70 dpa specimen, complete passivation of the specimen could not be obtained. AEM microanalysis showed changes in composition at both grain boundaries and faulted dislocation loops of chromium, iron, nickel, and silicon due to RIS.

7362 (DOE/ER–0313/12, pp. 250-255) **Effects of compositional modifications on the sensitization behavior of Fe-Cr-Mn steels.** Edgemon, G.L. (Georgia Inst. of Tech., Atlanta (United States)); Tortorelliik, P.F.; Bell, G.E.C. Oak Ridge National Lab., TN (United States). Jul 1992. In *Fusion Reactor Materials semiannual progress report for the period ending March 31, 1992.* 311p. Order Number DE92019053. Source: OSTI; NTIS; INIS.

The purpose of this task is to determine the corrosion susceptibility of reduced activation austenitic steels in aqueous environments for fusion applications involving water cooling and/or aqueous blankets. Fe-Cr-Mn steels may possibly be used in conjunction with aqueous blankets or coolants in a fusion device. Therefore, standard chemical immersion (modified Strauss) tests were conducted to characterize the effects of compositional modifications on the thermal sensitization behavior of these steels. A good correlation among weight losses, intergranular (IG) corrosion, and cracking was found. The most effective means of decreasing their susceptibility was through reduction of the carbon concentration of these steels to 0.1%, but the sensitization resistance of Fe-Cr-Mn-0.1C compositions was still inferior to type 304L and other similar stainless steels (SS). Alloying additions that form stable carbides did not have a very significant influence on the sensitization behavior.

7363 (DOE/ER–0313/12, pp. 256-262) **Lithium purification at temperature below 500 C.** Bell, G.E.C. (Oak Ridge National Lab., TN (United States)). Oak Ridge National Lab., TN (United States). Jul 1992. In *Fusion Reactor Materials semiannual progress report for the period ending March 31, 1992.* 311p. Order Number DE92019053. Source: OSTI; NTIS; INIS.

Fusion reactor designs incorporating molten lithium will need to be concerned with lithium purity due to materials compatibility and resulting activation transport considerations. Nonmetallic impurities in lithium, particularly nitrogen, can lead to increased materials compatibility problems and corrosion rates. A method for removal of nitrogen from liquid lithium has been investigated that allows nitrogen purification to be done at temperatures below 500 C. The method utilizes the formation of an insoluble, ternary compound on chromium-plated stainless steel surfaces to remove nitrogen. Capsule tests established the initial feasibility of the method and determined optimum warm-trapping parameters for a large-scale batch test. Favorable results from capsule tests were obtained with processing temperatures of 450 C by using a staged, large-scale batch process. When used in conjunction with conventional cold trapping, the method allows lithium purification to be done in a single, inexpensive vessel with a higher degree of safety, as compared to higher temperature methods (e.g., hot gettering).

7364 (DOE/ER–0313/12, pp. 265-270) **In-situ tritium recovery from Li_2O irradiated in fast neutron flux - Beatrix-II temperature change specimen.** Slagle, O.D. (Pacific Northwest Lab., Richland, WA (United States)); Hollenberg, G.W.; Kurasawa, T.; Verrall, R.A. Oak Ridge National Lab., TN (United States). Jul 1992. In *Fusion Reactor Materials semiannual progress report for the period ending March 31, 1992.* 311p. Order Number DE92019053. Source: OSTI; NTIS; INIS.

The Beatrix-II irradiation experiment is an in-situ tritium release experiment to evaluate the stability and tritium release characteristics of Li_2O under fast neutron irradiation to extended burnups. A thin annular ring specimen capable of temperature changes was irradiated in Phase I of the experiment to a lithium burnup of 5%. The primary emphasis of the test plan was to determine the effect and interrelationship of gas composition and temperature on the tritium inventory with increasing temperature and a series of specific temperature changes were carried out at intervals throughout the experiment to characterize the effect of burnup. Decreasing the amount of hydrogen in the sweep gas resulted in an increase in the tritium inventory in the Li_2O specimen. The tritium recovery during startup and shutdown was observed to be strongly influenced by the composition of the sweep gas.

7365 (DOE/ER–0313/12, pp. 273-282) **Radiation-induced changes in the physical properties of ceramic materials.** Zinkle, S.J. (Oak Ridge National Lab., TN (United States)); Hodgson, E.R. Oak Ridge National Lab., TN (United States). Jul 1992. In *Fusion Reactor Materials semiannual progress report for the period ending March 31, 1992.* 311p. Order Number DE92019053. Source: OSTI; NTIS; INIS.

It has become increasingly apparent in recent years that radiation-induced changes in the physical properties of ceramics will have a significant impact on the design of fusion reactors. Although ceramic components constitute only a small volume fraction of a fusion reactor plant (<1%), virtually every aspect of the heating, control, and diagnostic measurement of the fusion plasma is dependent on the satisfactory performance of a ceramic material. The results from recent studies on radiation-induced changes in the electrical conductivity, loss tangent, and thermal conductivity of ceramics are reviewed, with particular emphasis on in-situ data obtained during irradiation. The in-situ measurements have found that the physical property degradation during irradiation is generally much more severe than indicated by post-irradiation measurements. In particular, permanent degradation in the electrical resistivity may occur after irradiation to damage levels of $< 10^{-3}$ displacements per atom (dpa) for temperatures near 450 C. This radiation-induced electrical degradation (RIED) is observed only if an electric field is applied during the irradiation.

7366 (DOE/ER–0313/12, pp. 283-287) **Materials issues in diagnostic systems for BPX and ITER.** Clinard, F.W. (Los Alamos National Lab., NM (United States)); Farnum, E.H.; Griscom, D.L.; Mattas, R.F.; Wojtowicz, S.S.; Zinkle, S.J.; Medley, S.S.; Wiffen, F.W.; Young, K.M. Oak Ridge National Lab., TN (United States). Jul 1992. In *Fusion Reactor Materials semiannual progress report for the period ending March 31, 1992.* 311p. Order Number DE92019053. Source: OSTI; NTIS; INIS.

The objective of this work is to summarize the critical materials requirements for diagnostic systems in next-step burning plasma devices and reactor-like machines. For the first device the authors have chosen the Burning Plasma Experiment (BPX), which is now defunct but whose design is well-developed; for the latter machine they discuss needs for the International Thermonuclear Experimental Reactor (ITER). Anticipated radiation fluxes in D-T burning machines such as BPX and ITER are intense, and accumulated damage levels are moderate to severe. Thus, materials used in diagnostic systems may suffer significant degradation of electrical, optical, and structural properties, either from transient or permanent damage effects. Of particular concern are windows, optical fibers, reflectors, and insulators. However, materials design and modification based on results from an appropriate irradiation testing program, when combined with designs optimization for location, shielding, and ease of replacement, should point the way to development of acceptable materials systems.

7367 (DOE/ER–0313/12, pp. 288-295) **Observation of radiation-induced changes in dielectric properties in ceramic insulators.** Stoller, R.E. (Oak Ridge National Lab., TN (United States)); Goulding, R.H.; Zinkle, S.J.; Rasmussen, D.A. Oak Ridge National Lab., TN (United States). Jul 1992. In *Fusion Reactor Materials semiannual progress report for the period ending March 31, 1992.* 311p. Order Number DE92019053. Source: OSTI; NTIS; INIS.

The objective of this work is to investigate the effects of radiation on the electrical properties of ceramic insulators in order to qualify them for use in ITER. Several experiments have been completed in which the dielectric properties of ceramic materials were measured during ionizing and displacive irradiation. The experimental matrix included single crystal sapphire, commercial-grade polycrystalline alumina, magnesium-aluminate spinel, silicon nitride, and

aluminum nitride. These materials are candidates for use in a number of fusion reactor components. The measurements were made at 100 MHz using a capacitively-loaded resonant cavity. Essentially no effect of ionizing radiation alone was observed for damage rates up to about 5×10^5 Gy/h. However, pulsed fission reactor irradiation led to dramatic increases in the loss tangent. The fractional contributions of the ionizing and displacive fields to the total change observed during the neutron irradiations could not be unambiguously determined. The results of these experiments indicate that the use of post-irradiation measurements leads to an underestimate of the radiation-induced dielectric degradation that occurs in the radiation field.

7368 (DOE/ER–0313/12, pp. 296-297) **Measurement of electrical and optical properties of dielectric materials during neutron irradiation.** Farnum, E.H. (Los Alamos National Lab., NM (United States)); Clinard, F.W. Jr.; Kennedy, J.C. III; Sommer, W.F.; Unruh, W.P. Oak Ridge National Lab., TN (United States). Jul 1992. In *Fusion Reactor Materials semiannual progress report for the period ending March 31, 1992.* 311p. Order Number DE92019053. Source: OSTI; NTIS; INIS.

The objective of this experiment is to determine the extent of degradation of electrical and optical properties of candidate dielectric materials during neutron irradiation. The goals are to identify promising dielectrics for ITER and other fusion machines, characterize mechanisms of degradation, and establish the basis for optimization of candidate materials. An in-situ neutron irradiation experiment will be carried out at Los Alamos National Laboratory during the summer of 1992, to assess behavior of electrical insulators and optical fibers during neutron irradiation. Testing will be carried out at the Los Alamos Spallation Radiation Effects Facility (LASREF). Experiments include measurements of ac and dc electrical properties of Al_2O_3 at 300, 400, and 500 C, with applied electric fields up to 2,000 V/cm. Additional measurements will be carried out on MgO-insulated instrumentation cables. Tests on optical fibers include attenuation, fluorescence, and reflectance measurements, at ambient temperature and moderate to intense neutron fluxes. Results will be applied to identification and improvement of candidate materials for ITER and other fusion devices.

7369 (DOE/ER–0313/12, pp. 298-301) **The effect of phonon scattering by aluminum precipitates and voids on the thermal conductivity of Al_2O_3.** White, D.P. (Oak Ridge National Lab., TN (United States)). Oak Ridge National Lab., TN (United States). Jul 1992. In *Fusion Reactor Materials semiannual progress report for the period ending March 31, 1992.* 311p. Order Number DE92019053. Source: OSTI; NTIS; INIS.

This work is intended to provide information on the changes expected in the thermal conductivity of alumina due to phonon scattering by aluminum precipitates and voids. Recent calculations on the effect of vacancies and conduction band electrons on the thermal conductivity of Al_2O_3 have shown that large decreases in the conductivity may be expected due to the scattering of phonons by vacancies in material exposed to displacive radiation. This work has been extended to include the effects of aluminum precipitates and voids on the lattice thermal conductivity. The change in the thermal conductivity due to these extended defects is presented.

7370 (DOE/ER–0313/12, pp. 302-306) **In-waveguide measurements of MMW dielectric properties of ceramic materials for the US fusion reactor materials research program.** Kennedy, J.C. III (Los Alamos National Lab., NM (United States)); Farnum, E.F.; Clinard, F.W. Jr. Oak Ridge National Lab., TN (United States). Jul 1992. In *Fusion Reactor Materials semiannual progress report for the period ending March 31, 1992.* 311p. Order Number DE92019053. Source: OSTI; NTIS; INIS.

The objective is to obtain accurate measurements of dielectric properties of candidate ceramic insulating materials for fusion reactors. As part of an IEA collaboration, a set of round-robin materials was purchased for comparing dielectric measurements at laboratories in the United Kingdom, Spain, Germany, US, and Japan. P. Pells at Aldermasten, UK, purchased MACOR 9658, a glass-mica composite, and Roger Stoller, from ORNL, purchased WESGO AL-300 and AL-995, polycrystalline alumina standards. The authors obtained some of each of these materials for making these measurements. The results have been shared with the other IEA partners, and P. Pells is preparing a summary document. They used the millimeter wave apparatus described below and elsewhere in detail to measure the dielectric properties of these materials at 90 to 100 Ghz at room temperature. The nominal purity of AL-300 was 0.967; the nominal purity of AL-995 was 0.995. Their method was to measure the power transmission coefficient. They used computerized data reduction techniques to compute k (the dielectric constant) and tanδ (the loss tangent) directly from transmission maxima and their corresponding frequencies; to verify this method, they applied the same technique to theoretically derived channel spectra that were obtained by solving exactly the complex transmission coefficient, given k and tanδ. The alumina material with a lower level of purity resulted in higher loss but lower dielectric constant. They obtained dielectric constants that were higher for all the materials than manufacturer-reported values taken at lower frequencies. In addition, they obtained higher dielectric constant values than those found by other investigators at 100 GHz for AL-995 and MACOR. Tanδ values were in good agreement with those of other investigators obtained by free-space methods and dispersive Fourier-transform techniques in the same frequency range.

7371 (DOE/ER–0572T) **Fusion Energy Advisory Committee report on program strategy for US magnetic fusion energy research.** Conn, R.W. (California Univ., Los Angeles, CA (United States). Inst. of Plasma and Fusion Research); Baldwin, D.E.; Berkner, K.H.; Culler, F.L.; Davidson, R.C.; Dean, S.O. USDOE Office of Energy Research, Washington, DC (United States). Sep 1992. 79p. Sponsored by USDOE, Washington, DC (United States). Order Number DE93004626. Source: OSTI; NTIS; INIS; GPO Dep.

The Fusion Energy Advisory Committee (FEAC) was charged by the Department of Energy (DOE) with developing recommendations on how best to pursue the goal of a practical magnetic fusion reactor in the context of several budget scenarios covering the period FY 1994-FY 1998. Four budget scenarios were examined, each anchored to the FY 1993 figure of $337.9 million for fusion energy (less $9 million for inertial fusion energy which is not examined here).

7372 (DOE/ER/13735–T1) **Self shielding of surfaces irradiated by intense energy fluxes: Final report.** Varghese, P.L.; Howell, J.R.; Propp, A. Texas Univ., Austin, TX (United States). 1 Aug 1991. 167p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-87ER13735. Order Number DE93001704. Source: OSTI; NTIS; GPO Dep.

This dissertation will outline a direct methods of temperature, density, composition, and velocity measurement which should be widely applicable to railgun systems. The measurements demonstrated here should prove usefull basis for further studies of plasma/target interaction.

7373 (DOE/ER/40156–T1) **NRL HIFAR research program: Final progress report, FY 89–90.** Naval Research Lab., Washington, DC (United States). [1989]. 40p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI05-84ER40156. Order Number DE93004599. Source: OSTI; NTIS; INIS; GPO Dep.

The use of a beam of heavy ions to ignite a thermonuclear pellet places severe constraints on beam emittance throughout the accelerator system. Nonlinearities which occur during beam transport, acceleration, and focusing, can cause emittance growth which limits spot intensity. Because of the high beam intensities required to achieve ignition, details of the self-consistent evolution of nonlinear space charge forces are generally important in this process. Computer simulations have, in turn, become an important tool in examining beam dynamics in this nonlinear regime. The Naval Research Laboratory HIFAR research program has been a major contributor to the successful use of numerical simulation to understand the detailed mechanisms by which space charge nonlinearities can contribute to emittance growth and the dilution of beam intensity. This program has been conducted in close cooperation with LLNL and LBL personnel to maximize support for those programs. Codes developed at NRL have been extensively shared and models developed at the other laboratories have been incorporated in the NRL codes. Because of the collaborative nature of much of the work over the past year, which has emphasized the development of numerical tools and techniques for general use, progress has generally resulted from shared efforts. The work, as

reported here, emphasizes those contributions which can be attributed primarily to the NRL effort.

7374 (DOE/ER/51115–T1) **Equilibrium system analysis in a tokamak ignition experiment: Final report.** Carrera, R.; Weldon, W.F.; Woodson, H.H. Texas Univ., Austin, TX (United States). Center for Fusion Engineering. Oct 1989. 57p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-88ER51115. Order Number DE93006521. Source: OSTI; NTIS; INIS; GPO Dep.

The objective of the IGNITEX Project is to produce and control ignited plasmas for scientific study in the simplest and least expensive way possible. The original concept was proposed by both physics and engineering researchers along the following line of thought. Question: Is there any theoretically simple, compact and reliable way of achieving fusion ignition according to the results of the fusion research program for the last decades? Answer: Yes. An experiment to be carried out in an ohmically heated compact tokamak device with 20 T field on plasma axis. Question: Is there any practical way to carry out that experiment at low cost in the near term? Answer: Yes. Using a single-turn coil magnet system with homopolar power supplies.

7375 (DOE/ER/52111–5) **Application of railgun principle to high-velocity hydrogen pellet injection for magnetic fusion reactor fueling: Progress report, August 16, 1991–September 30, 1992.** Kim, K.; Zhang, J. Illinois Univ., Urbana, IL (United States). Fusion Technology Lab. [1992]. 40p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-84ER52111. Order Number DE93004563. Source: OSTI; NTIS; INIS; GPO Dep.

Three separate papers are included which report research progress during this period: (1) A new railgun configuration with perforated sidewalls, (2) development of a fuseless small-bore railgun for injection of high-speed hydrogen pellets into magnetically confined plasmas, and (3) controls and diagnostics on a fuseless railgun for solid hydrogen pellet injection.

7376 (DOE/ER/53264–3) **Low frequency rf current drive: Annual progress report.** Hershkowitz, N. Wisconsin Univ., Madison, WI (United States). Dept. of Nuclear Engineering and Engineering Physics. [1992]. 32p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER53264. Order Number DE93005130. Source: OSTI; NTIS; INIS; GPO Dep.

An unshielded antenna for rf heating has been developed and tested during this report period. In addition to design specifications being given, some experimental results are presented utilizing: (1) an unprotected Faraday shield, (2) insulating guard limiters, (3) unshielded antenna experiments, (4) method for detecting small rf driven currents, (5) rf fast wave current drive experiments, (6) alfven wave interactions with electrons, and (7) machine conditioning, impurity generation and density control.

7377 (DOE/ER/54084–T1) **Impurity pellet injection experiments at TFTR: Final performance report.** Marmar, E.S. Massachusetts Inst. of Tech., Cambridge, MA (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER54084. Order Number DE93005008. Source: OSTI; NTIS; INIS; GPO Dep.

Impurity (Li and C) pellet injection experiments on TFTR have produced a number of new and significant results. (1) We observe reproducible improvements of TFTR supershots after wall-conditioning by Li pellet injection ('lithiumization'). (2) We have made accurate measurements of the pitch angle profiles of the internal magnetic field using two novel techniques. The first measures the internal field pitch from the polarization angles of Li^* line emission from the pellet ablation cloud, while the second measures the pitch angle profiles by observing the tilt of the cigar-shaped Li^* emission region of the ablation cloud. (3) Extensive measurements of impurity pellet penetration into plasmas with central temperatures ranging from ~0.3 to ~7 keV have been made and compared with available theoretical models. Other aspects of pellet cloud physics have been investigated. (4) Using pellets as a well defined perturbation has allowed study of transport phenomena. In the case of small pellet perturbations, the characteristics of the background plasmas are probed, while with large pellets, pellet induced effects are clearly observed. These main results are discussed in more detail in this paper.

7378 (DOE/ER-ITER–0003) **The High Aspect Ratio Design (HARD): A candidate ITER concept with improved technology phase performance.** Nevins, W.M.; Perkins, L.J.; Wesley, J.C. (eds.). Lawrence Livermore National Lab., CA (United States). Oct 1992. 416p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48 ;AC05-84OR21400 ;AC02-76CH03073. (ITER/US–92/EN-SD-01). Order Number DE93003281. Source: OSTI; NTIS; INIS; GPO Dep.

The High Aspect Ratio Design (HARD) International Thermonuclear Experimental Reactor (ITER) concept developed by the US ITER team is an alternate to the low-aspect-ratio ITER design developed by the ITER participants during the Conceptual Design Activity (CDA). The CDA design, referred to hereafter as ITER CDA, has an aspect ratio, A, of 2.79, a toroidal magnetic field, B_T, of 4.85 T, and a plasma current, I_p, of 22 MA for operation with an ignited plasma. In contrast, HARD employs higher aspect ratio, A = 4.0, higher toroidal field, B_T = 7.11 T, and lower plasma current, I_p = 14.8 MA for ignition operation. The cross sections of the two designs are compared in. The parameters and performance of HARD and ITER CDA for inductively driven ignition operation are compared in. The HARD parameters provide the same ignition performance (ignition margin evaluated against ITER-89P confinement scaling) as ITER CDA in a device with comparable size and cost. However, the reason for advancing HARD rather than ITER CDA as the ITER design concept is not inductively driven ignition performance but HARD's significantly enhanced potential to achieve the technology testing and steady-state operation goals of the ITER objectives with non-inductive current drive.

7379 (DOE/ET/53088–576) **Magnetic reconnection at stressed x-type neutral points.** Ofman, L. (Texas Univ., Austin, TX (United States)); Morrison, P.J.; Steinolfson, R.S. Texas Univ., Austin, TX (United States). Inst. for Fusion Studies. Oct 1992. 35p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract FG05-80ET53088. Contract ATM-90-15705. (IFSR–576). Order Number DE93002167. Source: OSTI; NTIS; INIS; GPO Dep.

The reconnection and relaxation of two-dimensional stressed (non-potential) x-type neutral point magnetic fields are studied via solution of the nonlinear resistive 2-D MHD equations and by analytical solution of the linear eigenvalue problem. The linear dispersion relation was generalized for azimuthally nonsymmetric perturbations, and have found that for modes with azimuthal mode numbers $m > 0$, the relaxation can occur at a rate faster than that for $n = m = 0$, where n is the radial "quantum" number. One finds that for nearly azimuthally symmetric magnetic perturbations that are zero at the boundary; i.e. the "frozen-in" (sometimes called "fine-tied") boundary conditions, the fields relax incompressibly and nonlinearly to the unstressed x-type neutral point at a rate close to that predicted by linear theory. Also, fully compressible nonlinear MHD simulations have been performed, which show that the interaction between the plasma flow velocity and the magnetic field is the important physical effect, while the inclusion of thermodynamics does not affect the evolution considerably. A Lyapunov functional for the nonlinear incompressible 2-D resistive MHD equations is derived to show that the current-free x-point configuration is a global equilibrium to which general initial conditions relax.

7380 (GA-A–21044) **Advanced divertor program results from DIII-D.** Schaffer, M.J. (General Atomics, San Diego, CA (United States)); Brooks, N.H.; Evans, T.E.; Groebner, R.J.; Hinton, F.L.; Hollerbach, M.A.; Hyatt, A.W.; Jackson, G.L.; Leonard, A.W.; Lippmann, S.I.; Mahdavi, M.A.; Osborne, T.H.; Petrie, T.W.; Sevier, D.L.;General Atomics, San Diego, CA (United States). Sep 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-89ER51114 ;W-7405-ENG-48 ;AC03-89ER53277 ;AC05-84OR21400 ;FG03-89ER51121 ;AC04-76DP00789. (CONF-920913–20: 14. international conference on plasma physics and controlled nuclear fusion research, Wuerzburg (Germany), 30 Sep - 7 oct 1992; IAEA-CN–56/A-5-2). Order Number DE93002675. Source: OSTI; NTIS; INIS; GPO Dep.

This paper presents a summary of DIII-D boundary and diverter experiments directed at solving the scientific and technical problems of high power, long-pulse tokamak diverters. Single-null poloidal diverters were studied in the standard DIII-D open diverter configuration and in interaction with the toroidally symmetric ring biasing electrode and exhaust gas collection plenum. New results are reported for: scrape-off layer (SOL) transport; SOL density and unpurity influx; SOL density and diverter bias; ELM particle and energy content; ELMing SOL transport; open radiative diverter; passive exhaust gas collection; diverter bias and exhaust gas collection; diverter bias and H-mode threshold. The paper concludes with future plans for diverter research at DIII-D.

7381 (GA-A–21045) **Stability of TAE modes in DIII-D.** Strait, E.J. (General Atomics, San Diego, CA (United States)); Chu, M.S.; Lao, L.L.; Turnbull, A.D.; Heidbrink, W.W.; Duong, H.H. General Atomics, San Diego, CA (United States). Sep 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-89ER51114 ;FG03-89ER51121. (CONF-920913–23: 14. international conference on plasma physics and controlled nuclear fusion research, Wuerzburg (Germany), 30 Sep - 7 oct 1992). Order Number DE93002677. Source: OSTI; NTIS; INIS; GPO Dep.

TAE modes driven by neutral beam injection have been observed in DIII-D. The measured frequency agrees very well with theoretical predictions for DIII-D discharges. At large amplitude these instabilities can lead to loss of over 50% of the beam power, as well as large loss of non-resonant MeV fusion products. The threshold value of fast ion beta for destabilization and the observed range of unstable mode numbers are in reasonable agreement with predictions for the mode growth rate. Continuum damping dominates at low mode numbers, while damping by electron kinetic effects dominates at high mode numbers. Preliminary experiments suggest that TAB modes can be stabilized by current profile control.

7382 (INIS-BR–3091) **The FTI (Industrial Technology Foundation) magneto hydrodynamic program.** Pinatti, D.G. (Fundacao de Tecnologia Industrial (FTI), Lorena, SP (Brazil). Centro de Materiais Refratarios); Fernandes Filho, G.E.F. Fundacao de Tecnologia Industrial (FTI), Lorena, SP (Brazil). 1989[24] (CONF-8911255–: 3. workshop on combustion and propulsion, Lorena (Brazil), 28-30 Nov 1989). Order Number DE93610309. Source: OSTI; NTIS (US Sales Only); INIS.

Herein is described the magnetohydrodynamics program of FTI composed of three parts. The first is a wood acid hydrolysis plant used to prepare the lignin or lignin + cellulose to be used as fuel. The second is the top cycle of the plant composed of the combustor, MHD channel, diffuser, superconductor magnet and radiation heat exchanger. The third is the bottom cycle composed of primary boiler, secondary boiler, steam turbine, electrostatic separator, seed recovery system and metal heat exchanger. The plant has an oxygen plant and an argon washing unit as complementary equipment. The new feature of this technology is the use of carbonized lignin as a fuel that generates a plasma with very high electrical conductivity (150-100 S/M) allowing a compact plant with electrical efficiency on the order of 45%. (author).

7383 (INIS-mf–13204, pp. 47-50) **Engineering analysis of new Brazilian Tokamak.** Tuszel, A.G. (Sao Paulo Univ., SP (Brazil). Inst. de Fisica). Comision Nacional de Energia Atomica, Buenos Aires (Argentina); International Atomic Energy Agency, Vienna (Austria); Secretaria de Ciencia y Tecnica, Buenos Aires (Argentina). 1990. [368] (CONF-900739–: 4. Latin American workshop on plasma physics, Buenos Aires (Argentina), 16-27 Jul 1990). In *Fourth Latin-American workshop on Plasma Physics (held in) Buenos Aires, Argentina, 16-27 Jul 1990. Contributed papers.* Order Number DE92635466. Source: OSTI; NTIS (US Sales Only); INIS.

The engineering basic headlines are described. A project for the construction of a new tokamak is being developed at the Institute of Physics, University of Sao Paulo. The tokamak named TBR-II will be a medium size tokamak using two high power generators of 15 MW each and concepted as a versatile device for plasma physics research of interest for thermonuclear fusion studies. (Author).

7384 (INIS-mf–13204, pp. 136-139) **Experimental investigation of current shedding and pinch ratio in deuterium pinches.** Gholap, A.V. (Zimbabwe Univ., Harare (Zimbabwe)); Alabraba, M.A.; Sigalo, F.B. Comision Nacional de Energia Atomica, Buenos Aires (Argentina); International Atomic Energy Agency, Vienna (Austria); Secretaria de Ciencia y Tecnica, Buenos Aires (Argentina). 1990. [368] (CONF-900739–: 4. Latin American workshop on plasma physics, Buenos Aires (Argentina), 16-27 Jul 1990). In *Fourth Latin-American workshop on Plasma Physics (held in) Buenos Aires, Argentina, 16-27 Jul 1990. Contributed papers.* Order Number DE92635466. Source: OSTI; NTIS (US Sales Only); INIS.

The current reduction factor and quasi equilibrium pinch ratio in deuterium plasma at different pressures have been investigated from the experimental V-I oscillograms in UNU-ICTP Plasma Focus Fusion Facility. The current reduction factor varied from 0.62 to 0.78 while the pinch ratio varied from 0.11 to 0.15 as the deuterium pressure was changed from 1.2 torr to 5.0 torr. (Author).

7385 (INIS-mf–13204, pp. 112-115) **Impulsive and quasistatic breakdown voltage behavior in a coaxial plasma gun.** Feugeas, J.N. (Rosario Univ. Nacional (Argentina). Inst. de Fisica); Pamel, O. von. Comision Nacional de Energia Atomica, Buenos Aires (Argentina); International Atomic Energy Agency, Vienna (Austria); Secretaria de Ciencia y Tecnica, Buenos Aires (Argentina). 1990. [368] (CONF-900739–: 4. Latin American workshop on plasma physics, Buenos Aires (Argentina), 16-27 Jul 1990). In *Fourth Latin-American workshop on Plasma Physics (held in) Buenos Aires, Argentina, 16-27 Jul 1990. Contributed papers.* Order Number DE92635466. Source: OSTI; NTIS (US Sales Only); INIS.

The breakdown voltage in a coaxial electrode system with a geometry similar to the one used as a plasma focus is studied for two different discharge conditions: a) a quasistatic condition in which the voltage applied on the electrodes has a low rise time and b) an impulsive condition in which the voltage is applied with a high rise time. The experiments were done for both situations in a low pressure hydrogen atmosphere. (Author).

7386 (INIS-mf–13204, pp. 355-358) **Field reversed theta pinch TC-I UNICAMP.** Honda, R.Y. (Universidade Federal Fluminense, Niteroi, RJ (Brazil)); Machida, M.; Aramaki, E.A.; Porto, P.; Berni, L.A. Comision Nacional de Energia Atomica, Buenos Aires (Argentina); International Atomic Energy Agency, Vienna (Austria); Secretaria de Ciencia y Tecnica, Buenos Aires (Argentina). 1990. [368] (CONF-900739–: 4. Latin American workshop on plasma physics, Buenos Aires (Argentina), 16-27 Jul 1990). In *Fourth Latin-American workshop on Plasma Physics (held in) Buenos Aires, Argentina, 16-27 Jul 1990. Contributed papers.* Order Number DE92635466. Source: OSTI; NTIS (US Sales Only); INIS.

Field reversed configuration TC-I device is 16 cm diameter, 1 meter long with two mirror coils and 30 kJ field reversed theta pinch working for over two years at University of Campinas. Its implosion dynamics and field reversal parameters have been studied using flux excluded loops, internal magnetic probe, visible spectroscopy, photodiode array and image converter camera. The vacuum vessel is a pyrex tube of 14,5 cm diameter pumped with a liquid nitrogen cooled diffusion pump to a base pressure of 6×10^{-7} Torr. The schematic view of the machine and experimental set up are shown. (Author).

7387 (JAERI-M–92-063) **Some ITER shield problems examination.** Zimin, S. (Japan Atomic Energy Research Inst., Naka, Ibaraki (Japan). Naka Fusion Research Establishment); Satoh, Satoshi; Takatsu, Hideyuki; Seki, Yasushi; Maki, Koichi; Kuroda, Toshimasa. Japan Atomic Energy Research Inst., Tokyo (Japan). May 1992. 54p. Order Number DE93753132. Source: OSTI; NTIS; INIS.

A study on shielding problems of the International Thermonuclear Experimental Reactor (ITER) is presented. Considerable effort was spent on the design of the blanket and shield of ITER during Conceptual Design Activities (CDA) Phase of work. However, many problems of shielding are to be solved during Engineering Design Activities (EDA) Phase of work. The study has been performed to solve some ITER shielding problems and to rise up others which are to be solved. The present study is composed of four parts, each of which dedicated to a group of common problems which are a greater concern in terms of shielding performance. These

group are the inboard ITER shield problems, outboard ITER shield problems, top/bottom ITER shield problems and shielding recommendations in connection with the ITER maintenance. Most of problems were solved analytically by extrapolations of previous results of neutron transport calculations on the design elaborated in Japan after the CDA. The problem of neutron streaming through the ITER divertor piping was solved by carrying out neutron transport calculations for the two-dimensional DOT3.5 code. (author).

7388 (JAERI-M–92-066) **Preliminary test of liquid metal induced embrittlement in liquid lipb and stainless-steel systems.** Yoshida, Hiroshi (Japan Atomic Energy Research Inst., Naka, Ibaraki (Japan). Naka Fusion Research Establishment); Enoeda, Mikio; Naruse, Yuji; Shige, Takashi; Hasegawa, Misao. Japan Atomic Energy Research Inst., Tokyo (Japan). May 1992. 59p. Order Number DE93753130. Source: OSTI; NTIS; INIS.

Corrosion of structural materials with molten metal is one of major concerns of the feasibility of this concept. Many experimental works have been performed to examine the reactivity of eutectic Li17Pb83 with stainless-steel, and proved that the reactivity of it with structure materials is lower than that of the other molten breeders such as Li and LiF-BeF2. Several investigators have reported that weldments of Cr-Mo ferritic steel degradate with liquid LiPb because of the liquid metal induced embrittlement (LMIE) phenomena. Present study was aimed at the susceptibility of LMIE in the LiPb-steel system under various stress conditions. Tests were done with Li17Pb83 and pure Pb at 500degC. Test specimens of U-bend, tensiled-rod and weldments were prepared from austenitic (SUS316) and ferritic (modified 9Cr-1Mo) steels. At high stress condition of 70 % of break stress, generation of microcracks was observed. (author).

7389 (JAERI-M–92-069) **JT-60 Upgrade vertical stability experiments and analysis.** Humphreys, D.A. (Japan Atomic Energy Research Inst., Naka, Ibaraki (Japan). Naka Fusion Research Establishment); Yoshino, Ryuji. Japan Atomic Energy Research Inst., Tokyo (Japan). May 1992. 31p. Order Number DE93753131. Source: OSTI; NTIS; INIS.

The JT-60 Upgrade tokamak (JT-60U), can produce plasmas with vertical elongation ($\kappa \simeq 1.6$), and thus allows investigation of vertical instability phenomena. The present work describes investigation of the vertical stability characteristics of JT-60U plasmas through experimental results and simulation. Experiments described include feedback turnoff cases and high β_p unstable plasma cases. For purposes of simulation, the plasma is modeled as a rigid assembly of current-carrying axisymmetric loops. A nominal conductor model based on design geometry was modified to reproduce the results of a series of coil excitation experiments using a reduced order system identification approach. A two-coil model was used to fit the experimental coil excitation behavior, and the full order conductor model was modified to allow the dominant modes to reflect the low order dynamic response. The resulting plasma-conductor model is shown to reproduce the vertical stability behavior of JT-60U fairly well. Theoretical predictions of limits on the value of Shafranov Λ achievable in JT-60U are made. (author).

7390 (JAERI-M–92-070) **Test apparatus for ITER blanket cooling water distributor design.** Yoshida, Hiroshi (Japan Atomic Energy Research Inst., Naka, Ibaraki (Japan). Naka Fusion Research Establishment); Enoeda, Mikio; Hirata, Shingo; Ito, Hideki. Japan Atomic Energy Research Inst., Tokyo (Japan). May 1992. 55p. (In Japanese). Order Number DE93753157. Source: OSTI; NTIS; INIS.

Current Japanese breeding blanket concept being developed for the ITER driver blanket is comprised of three breeding layers, nine multiplier layers and five water cooling panels. In order to meet design requirements of tritium release efficiency and material temperature restrictions, configuration of these layers should be designed to achieve optimum temperature profiles in the radial direction of the blanket. Such temperature conditions are attained by appropriate water flow rate distribution in each cooling panel. Furthermore, the cooling panel must be designed to accommodate variation of D-T burning plasma density during ITER operation. We have developed an engineering test apparatus composed of three parallel cooling panel models. It was designed to examine performance of orifice type passive distributions for cooling header design. The apparatus can be operated under ITER blanket design conditions: temperature range; 60 - 100degC, water pressure; 1.5MPa, flow rate; 0.5-5m/s, pressure drop; up to 50kPa, heat flux of heater; 20-2000kW/m^2. (author).

7391 (JAERI-M–92-083) **Measurements of breakaway reaction between beryllium and water vapor for ITER blanket design.** Yoshida, Hiroshi (Japan Atomic Energy Research Inst., Naka, Ibaraki (Japan). Naka Fusion Research Establishment); Enoeda, Mikio; Ashibe, Kusuo; Ono, Kiyoshi. Japan Atomic Energy Research Inst., Tokyo (Japan). Jun 1992. 35p. Order Number DE93753270. Source: OSTI; NTIS; INIS.

Beryllium will be utilized as the neutron multiplier in the ITER breeding blanket. As part of Japanese contribution of the water-cooled blanket design, preliminary study was performed to investigate beryllium breakaway reaction, which is one of safety issues of ITER under high temperature conditions. Thermogravimetric measurements in the temperature range 550 - 750 degC were carried out under helium gas flow containing water vapor of 7.6 and 0.76 Torr. The test samples were prepared from commercially available hot-pressed and hot-rolled beryllium plates. Characterization of the surface reaction product was performed by macro and microscopic observations, and X-ray diffraction analysis. Linear and parabolic rate laws were found for the dominant reaction steps in the preceding period of the breakaway reaction. Microstructure of the surface reaction layer formed in all exposure conditions revealed brittle structure, which was composed of blister and microcracks. The rate equations were obtained for the preceding step of breakaway reaction. (J.P.N.).

7392 (JAERI-M–92-093) **Heterogeneous effects on shielding characteristics in fusion reactor neutronics calculations.** Sato, Satoshi (Japan Atomic Energy Research Inst., Naka, Ibaraki (Japan). Naka Fusion Research Establishment); Seki, Yasushi; Takatsu, Hideyuki; Zimin, S.; Maki, Koichi; Kuroda, Toshimasa. Japan Atomic Energy Research Inst., Tokyo (Japan). Jul 1992. 61p. (In Japanese). Order Number DE93753285. Source: OSTI; NTIS; INIS.

Heterogeneous effects in shielding calculations were evaluated in terms of shielding characteristics of a blanket/shield structure to superconducting magnets (SCM) of a fusion reactor. A wide range of parameters was examined such as thicknesses of individual steel/water layers composing shield region and thicknesses of shield and blanket regions and the following results were obtained. With a constant thickness of a shield region of 70 cm, the heterogeneous effects increased with the thickness of individual steel/water layers in shield region. In the case the thicknesses of individual steel/water layers were smaller than 2 cm/5 mm, the heterogeneous effects both in the coil case and in the winding pack of SCM were less than 3 %. In the case the thicknesses of steel/water layers were 12 cm/3 cm, the heterogeneous effects in the winding pack and in the coil case were 20 % and 9 %, respectively. The heterogeneous effects both in the coil case and in the winding pack increased with the total thickness of the shield region, and saturated at 18 % and 13 %, respectively, under the constant thickness of individual steel/water layers in the shield region of 8 cm/2 cm. The heterogeneous effects showed a negligible dependence on the thickness of the blanket region and on addition of supplemental shield such as boron carbide and lead layers. The heterogeneous effects were examined for the inboard blanket of an International Thermonuclear Experimental Reactor (ITER) based on its conceptual design. The heterogeneous effects of nuclear heating rates in the coil case and in the winding pack were found to be 27 % and 29 %, respectively, and to be within a safety factor of 30 % for an error of modeling assumed in the conceptual design of the ITER. (author).

7393 (JAERI-M–92-094) **Structural design of cryostat and port penetration of international thermonuclear experimental reactor (ITER).** Sawa, Masafumi (Japan Atomic Energy Research Inst., Naka, Ibaraki (Japan). Naka Fusion Research Establishment); Kanamori, Naokazu; Shimizu, Katsuhiro; Nomura, Yukio; Ohkawa, Yoshinao; Shibanuma, Kiyoshi; Tada, Eisuke. Japan Atomic Energy Research Inst., Tokyo (Japan). Jul 1992. 110p. (In Japanese). Order Number DE93753267. Source: OSTI; NTIS; INIS.

Preliminary structural design of the ITER cryostat and port penetration based on concrete cryostat was conducted and the

structural concept compatible with remote handling and nuclear shielding is proposed. The ITER cryostat was mainly composed of side wall, upper cover, upper port, horizontal port, vacuum port, cooling pipe penetration. The upper cover is designed to be fully detachable structure by remote handling for assembling/disassembling the poloidal field coils. In addition, the upper cover provides the biological shield for personal access for the blanket maintenance operation. The upper port is designed to meet the requirements of cooling pipe penetration, blanket maintenance and biological shield. The layout of the cooling pipe is defined by simple thermal stress analysis. There are 16 horizontal ports arranged around the cryostat to provide the access of heating and current drive system, fuel injection, blanket test modules, vacuum pump and remote handling manipulators. Each port should have the biological shield and bellows to prevent an excessive thermal stress due to thermal expansion. These bellows are non-circular cross-section and the reinforced structure to prevent buckling is proposed. A partial model of the seal mechanism applicable to large gate valves connected to the horizontal ports was fabricated and the basic performance under cyclic loading has been investigated. As a whole, the design concept of the cryostat and port penetration has been successfully developed and more detailed analysis and critical technology development will be conducted in the Engineering Design Phase. (author).

7394 (JAERI-M–92-100) **Safety handling of beryllium for fusion technology R and D.** Yoshida, Hiroshi (Japan Atomic Energy Research Inst., Naka, Ibaraki (Japan). Naka Fusion Research Establishment); Okamoto, Makoto; Terai, Takayuki; Odawara, Osamu; Ashibe, Kusuo; Ohara, Atsushi. Japan Atomic Energy Research Inst., Tokyo (Japan). Jul 1992. 105p. (In Japanese). Order Number DE93753302. Source: OSTI; NTIS; INIS.

Feasibility of beryllium use as a blanket neutron multiplier, first wall and plasma facing material has been studied for the D-T burning experiment reactors such as ITER. Various experimental work of beryllium and its compounds will be performed under the conditions of high temperature and high energy particle exposure simulating fusion reactor conditions. Beryllium is known as a hazardous substance and its handling has been carefully controlled by various health and safe guidances and/or regulations in many countries. Japanese regulations for hazardous substance provide various guidelines on beryllium for the protection of industrial workers and environment. This report was prepared for the safe handling of beryllium in a laboratory scale experiments for fusion technology R and D such as blanket development. Major items in this report are; (1) Brief review of guidances and regulations in USA, UK and Japan. (2) Safe handling and administration manuals at beryllium facilities in INEL, LANL and JET. (3) Conceptual design study of beryllium handling facility for small to mid-scale blanket R and D. (4) Data on beryllium toxicity, example of clinical diagnosis of beryllium disease, and environmental occurence of beryllium. (5) Personnel protection tools of Japanese Industrial Standard for hazardous substance. (author) 61 refs.

7395 (JAERI-M–92-104) **Test apparatus for ITER blanket pebble packing behavior.** Enoeda, Mikio (Japan Atomic Energy Research Inst., Naka, Ibaraki (Japan). Naka Fusion Research Establishment); Yoshida, Hiroshi; Hirata, Singo; Ishida, Katutoshi. Japan Atomic Energy Research Inst., Tokyo (Japan). Jul 1992. 34p. (In Japanese). Order Number DE93753304. Source: OSTI; NTIS; INIS.

Current Japanese design for ITER Driver Blanket consists of three breeder layers, nine multiplier layers and five cooling panels. The breeder layers and the multiplier layers contain 1 mm diameter spheres of Li_2O and Be, respectively. The heat transfer in such 'Pebble Layered Blanket' is largely affected by the packing fraction of the pebbles which can be easily changed by the vibration during the operation. The packing fraction of the pebbles are expected to be as high as possible on the view point of nuclear heat design to maintain the optimum temperature of the breeder layer. Thus, it is necessary to establish the stable packed bed of the breeder and multiplier. The present experimental apparatus was fabricated for the engineering tests with the partial model of Japanese blanket. Test apparatus consists of stainless steel test panels, transparent plastic test panels, vibrators and measurement instruments. The apparatus can examine various parameters of sphere packed beds such as packing fraction, panels deformation, loading weight at the bottom of the panels and so on under various vibrating conditions. (author).

7396 (JAERI-M–92-120) **A study on radiation shielding analysis for toroidal field coils of a tokamak-type fusion reactor.** Zimin, Sergei (Japan Atomic Energy Research Inst., Naka, Ibaraki (Japan). Naka Fusion Research Establishment). Japan Atomic Energy Research Inst., Tokyo (Japan). Aug 1992. 226p. Order Number DE93753398. Source: OSTI; NTIS; INIS.

A study on the radiation shield for toroidal field (TF) coils of a tokamak type fusion device is reported. The study was performed to provide the design data base for the radiation shielding analysis for TF coils which can be commonly used for other systems, and to produce some universal recommendation about the neutron flux attenuation in the shield of a fusion reactor. Some simple estimation procedure instead of difficult and expensive neutron calculation can be carried out in this case on the basis of the fundamental knowledge on neutron behavior. The present studies are composed of the fundamentals required for shield estimation, the analysis of shield effectiveness, the analysis of the shielding performance of blankets, the analysis of radiation permeating through the inhomogeneous blanket and shield of a fusion reactor, and the analysis of the TF coil shield of the International Thermonuclear Experimental Reactor (ITER) on the basis of the results of the ITER conceptual design activities for three years. The methodological recommendation was developed for the ANISN and the DOT3 codes. (K.I.).

7397 (KFK–5028) **Results of dose calculations for NET accidental and normal operation releases of tritium and activation products.** Raskob, W.; Hasemann, I. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Kernfusion. Aug 1992. 163p. Order Number DE93744883. Source: OSTI; NTIS (US Sales Only); INIS.

This report documents conditions, data and results of dose calculations for accidental and normal operation releases of tritium and activation products, performed within the NET subtask SEP2.2 ('NET-Benchmark') of the European Fusion Technology Programme. For accidental releases, the computer codes UFOTRI and COSYMA for assessing the radiological consequences, have been applied for both deterministic and probabilistic calculations. The influence on dose estimates of different release times (2 minutes /1 hour), two release heights (10 m /150 m), two chemical forms of tritium (HT/HTO), and two different model approaches for the deposition velocity of HTO on soil was investigated. The dose calculations for normal operation effluents were performed using the tritium model of the German regulatory guidelines, parts of the advanced dose assessment model NORMTRI still under development, and the statistical atmospheric dispersion model ISOLA. Accidental and normal operation source terms were defined as follows: 10g ($3.7\ 10^{15}$ Bq) for accidental tritium releases, 10 Ci/day ($3.7\ 10^{11}$ Bq/day) for tritium releases during normal operation and unit releases of 10^9 Bq for accidental releases of activation products and fission products. (orig./HP).

7398 (KFK–5051) **LIBRA-LITE: A commercial size light ion fusion power plant.** Badger, B. (Wisconsin Univ., Madison, WI (United States). Fusion Technology Inst.); Choi, B.; Engelstad, R.L.; Kulcinski, G.L.; Lovell, E.G.; MacFarlane, J.J.; Mogehed, E.A.; Moses, G.A.; Peterson, R.R.; Rutledge, S.; Sawan, M.E.; Sviatoslavsky, G.; SviatoKernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Kernfusion. May 1992. 133p. (UWFDM–880;FPA–91-4). Order Number DE93744881. Source: OSTI; NTIS (US Sales Only); INIS.

LIBRA-LITE is a concept study for future 1000 MWe nuclear fusion reactors operating on the principle of inertial confinement. Light ions, e.g. lithium ions, are given an energy of 25-35 MeV in an accelerator and focused symmetrically onto a target (deuterium-tritium filled sphere of 7 mm diameter) in a reactor chamber. The fusion reaction is ignited by shock wave induced compression of the target. The radiation (photons, neutrons, ions) is absorbed in a blanket where the thermal power is removed by a coolant and tritium is rebred. The LIBRA-LITE concept study is the continuation

of the earlier LIBRA study (330 MWe) with a modified concept of light ion beam focusing. Starting from an ion source (diode), the lithium ion beams are focused ballistically onto the target. For this to be achieved, lithium must be used as the coolant in the reactor chamber and the blanket concept must be slightly modified by providing steel tubes (HT-9) as guiding tubes for the coolant flow. A particular engineering problem to be solved are the ion beam focusing magnets, which have to extend rather closely up to the center of the reactor chamber. (orig.).

7399 (LA-UR–92-3001) **Tritium technology development under 5-year US-Japan collaboration at TSTA.** Anderson, J.L. (Los Alamos National Lab., NM (United States)); Bartlit, J.R.; Naruse, Yuji. Los Alamos National Lab., NM (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-920930–4: 17. symposium on fusion technology, Rome (Italy), 14-18 Sep 1992). Order Number DE93000684. Source: OSTI; NTIS; INIS; GPO Dep.

In 1987 the US Department of Energy (DOE) and th Japan Atomic Energy Research Institute (JAERI) signed collaborative aggrement for the joint operation and join funding of the Tritium Systems Test Assembly (TSTA) for a five year period ending June 1992. The tritium research and development accomplished during this five year period has provided a very valuable data base for the fusion energy program. During the past year a number of significant experiments were completed and major programmatic milestones were met. This paper summarizes some of the major accomplishments during the initial five year collaboration. The integrated TSTA gas processing loop was operated continuously for 25 days. Both the JAERI fuel cleanup system and the original TSTA fuel cleanup system were operated under similar conditions of flow, pressure, and impurity content of the DT gas. The isotope separation system was operated continuously, using the recently installed laser Raman spectroscopy system for in situ analysis of the gas in the loop. Additional studies include studies on the interaction of tritium with sulfur hexaflouride, studies on the compatibility of cryosorption pump materials with tritium, and studies of tritium interaction with gaseous materials such as methane and deuterated methane.

7400 (LA-UR–92-3324) **Regeneration and tritium recovery from the large JET neutral injection cryopump system after the FTE.** Obert, W. (JET Joint Undertaking, Abingdon (United Kingdom)); Bell, A.; Davies, J.; Mayaux, C.; Perinic, G.; Saibene, G.; Sartori, R.; Thompson, E.; Anderson, J.; Jenkins, E.; Walthers, C. Los Alamos National Lab., NM (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-920930–14: 17. symposium on fusion technology, Rome (Italy), 14-18 Sep 1992). Order Number DE93003739. Source: OSTI; NTIS; INIS; GPO Dep.

Neutral Beam Injection (NBI) was used to introduce tritium into the plasma for the First Tritium Experiment In addition to the decisive advantage of depositing the tritium into the centre of the plasma, the use of NBI also minimized the total quantity of tritium introduced into the Torus and the contamination of the vacuum vessel. However, because of the relatively low gas efficiency of the positive ion injection system approximately 95% of the total quantity of tritium introduced was pumped by the large condensation cryopumps which form an integral part of the injector. Several hardware and associated software changes were implemented in order to making provision for possible fault scenarios during operation with tritium and to ensure complete regeneration of the tritium from the cryopumps. The tritium released after all subsequent regeneration's has been monitored carefully in order to determine the amount of tritium retained by the black anodized liquid nitrogen panel surfaces of the cryopump and to compare it with experiments at TSTA on JET samples before the FTE.

7401 (LA-UR–92-3711) **Explosively driven opening switch for the 20-megampere Procyon experiments.** Goforth, J.H. (Los Alamos National Lab., NM (United States)); Oona, H.; Fowler, CM; Greene, A.E.; Herrera, D.H.; King, J.C.; Martinez, E.C; Parker, J.V.; Seitz, G.J.; Turchi, P.J. Los Alamos National Lab., NM (United States). [1992]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-921133–7: 6. international conference on megagauss magnetic field generation and related topics, Albuquerque, NM (United States), 9-12 Nov 1992). Order Number DE93003818. Source: OSTI; NTIS; GPO Dep.

The Los Alamos foil implosion program has growing needs for large pulsed power systems. We are developing the Procyon explosive pulsed power system to drive ~ 15-MA, 3-μs experiments, and we have previously published considerations involved in the system design. Results of four tests conducted in the initial Procyon development series have also been published. From these tests we concluded that it is possible to supply the curent for 1-MJ kinetic energy plasma z-pinch implosions. Capacitor bank failures on two subsequent tests have slowed our progress, but from these tests we have developed confidence in the precision of our explosively formed fuse (EFF) triggering processes. In this paper, we will summarize the results to date, and describe the performance of our EFF and its triggering system.

7402 (LA-UR–92-3759) **Explosive pulse power for fusion applications.** Reinovsky, R.E.; Lindemuth, I.R.; Marsh, S.P.; Lopez, E.A. Los Alamos National Lab., NM (United States). [1992]. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-921133–5: 6. international conference on megagauss magnetic field generation and related topics, Albuquerque, NM (United States), 9-12 Nov 1992). Order Number DE93003828. Source: OSTI; NTIS; INIS; GPO Dep.

Explosive pulse power systems, powered by flux compression generators and including a variety of high current power conditioning components, such as high current opening switches, are attractive for powering fusion physics experiments which require 10's MJ of electrical energy. Such systems are economical when compared to other high energy sources and require little capital investment to enable initial experiments. They are flexible and readily reconfigurable to accommodate changing experimental requirements and can be designed, assembled and fielded in relatively short periods of time. Several configurations of very high energy flux compressors have been explored at Los Alamos and recently Russian researchers at the All Russian Institute of Experimental Physics (VNIIEF) have reported notable results from modular systems based on disk concepts. In this paper we describe a phenomenological model of disk flux compressors. The performance predicted by these models is in sufficiently good agreement with the results reported by VNIIEF researchers to allow the model to be applied, in the future, to the design of power conditions systems for use in conjunction with these high performance generators.

7403 (NIFS–128) **New high voltage parallel plate analyzer.** Hamada, Y.; Kawasumi, Y.; Masai, K.; Iguchi, H.; Fujisawa, A.; Abe, Y. National Inst. for Fusion Science, Nagoya (Japan). Jan 1992. 17p. Order Number DE93753083. Source: OSTI; NTIS; INIS.

A new modification on the parallel plate analyzer for 500 keV heavy ions to eliminate the effect of the intense UV and visible radiations, is successfully conducted. Its principle and results are discussed. (author).

7404 (NIFS–144) **Helical divertor in the Large Helical Device.** Ohyabu, N. (and others); Noda, N.; Ji, H. National Inst. for Fusion Science, Nagoya (Japan). May 1992. 22p. Order Number DE93753195. Source: OSTI; NTIS; INIS.

The Large Helical device (LHD), now under construction is a Heliotron /torsatron device with a closed divertor system. The edge LHD magnetic structure has been studied in detail. A peculiar feature of the configuration is existence of edge surface layers, a complicated three dimensional magnetic structure. However it does not seem to hamper the expected divertor functions. As a confinement improvement scheme in LHD, we have proposed a high temperature divertor plasma operation in which a divertor plasma with temperature of a few kev, generated by efficient pumping, leads to the confinement improvement. Conceptual designs of the LHD divertor components are under way. (author).

7405 (NIFS–149) **Production of negative hydrogen ions in a large multicusp ion source with double-magnetic filter configuration.** Ando, A.; Takeiri, Y.; Kaneko, O.; Oka, Y.; Wada, M.; Kuroda, T. National Inst. for Fusion Science, Nagoya (Japan). May 1992. 42p. Order Number DE93753200. Source: OSTI; NTIS; INIS.

The production of the negative hydrogen ions in a large multicusp ion source has been investigated in a double-magnetic filter

(DMF) configuration. In the DMF configuration, the energetic electrons are trapped by the mirror of a magnetic multicusp field, and only the thermal electrons are present in the center of the arc chamber. A large amount of H^- ions of more than 1×10^{12} cm^{-3} are produced in the center region. The electron current extracted with the H^- ions can be suppressed by a magnetic filter field in front of a plasma grid without affecting the H^- ion current. The experimental data obtained in the DMF configuration are compared with those obtained in a single-magnetic filter (SMF) configuration. In the SMF configuration, the energetic electrons are present in the center region, and the magnetic filter in front of a plasma grid reduces the electron density and temperature, which results in the reduction of H^- ion current as well as the electron current. The extracted electron current and the optimum gas pressure for the H^- ion current are lower in the DMF configuration that those in the SMF configuration. (author).

7406 (NIFS–151) **Negative ion extraction characteristics of a large negative ion source with double-magnetic filter configuration.** Takeiri, Y.; Ando, A.; Kaneko, O.; Oka, Y.; Kuroda, T. National Inst. for Fusion Science, Nagoya (Japan). May 1992. 33p. Order Number DE93753202. Source: OSTI; NTIS; INIS.

A multi-ampere hydrogen negative ion source with a large extraction area of 25 cm x 25 cm has been developed. This negative ion source is a volume-production-type bucket ion source which is operated with double-magnetic filter configuration. In this configuration, the fast electrons, which produce the vibrationally excited molecules, are trapped near the chamber wall by the cusp field, which is the first magnetic filter. In the central region of the arc chamber, these exist only the thermal electrons with low temperature. As a result, the negative ions are produced in the central region by dissociative attachment. A rod magnetic filter in front of the plasma grid, which is the second magnetic filter, is utilized for reducing the population of the electrons in the vicinity of the plasma grid, which are extracted together with the negative ions. By this structure the extracted electron current can be controlled independently of the H^- ion current. So far, a 1.4A of H^- ion current has been obtained with the energy of 34 keV. Negative ion extraction characteristics of this ion source, such as the arc power dependence and the gas pressure dependence, are presented. (author).

7407 (NIFS–152) **Review of high Z materials for PSI applications.** Tanabe, Tetsuo (Osaka Univ., Suita (Japan). Faculty of Engineering); Noda, Nobuaki; Nakamura, Hiroo. National Inst. for Fusion Science, Nagoya (Japan). Jun 1992. 50p. Order Number DE93753203. Source: OSTI; NTIS; INIS.

Application of carbon based low Z materials to PFM has significantly improved plasma parameters in large tokamaks. There are, however, serious concerns of erosion, neutron damage etc. for application of low Z materials in future D - T burning machine. To apply high Z metals to PFM, there are several issues to be solved; high Z impurity production by sputtering, their accumulation in plasma center, and high radiation loss. Because of these concerns high Z metals are not widely employed nor planned to be used in the present large tokamaks. Since our efforts have been concentrated to optimize the low Z materials, little systematic investigations for high Z materials in tokamak have been done, lacking data base especially those concerning the impacts on plasma core. In order to employ high Z material as PFM near future, material properties related to impurity production and hydrogen recycling are reviewed and discussed what is important and what shall be done. (author) 109 refs.

7408 (NIFS–160) **Effects of nonclassical ion losses on radial electric field in CHS torsatron/heliotron.** Sanuki, Heiji; Itoh, Kimitaka; Itoh, Sanae. National Inst. for Fusion Science, Nagoya (Japan). Jul 1992. 52p. Order Number DE93754331. Source: OSTI; NTIS; INIS.

A selfconsistent analysis is discussed to determine the radial electric field and loss cone boundary in torsatron/heliotron plasmas under the influence of nonclassical ion losses. Effects of the loss cone loss, charge exchange loss of fast ions with neutrals, and the bipolar part of anomalous loss are taken into account. Analysis is applied to the NBI heated plasma in the CHS device. Comparison is made between theoretical results and experimental observations. The increased ion particle losses by the orbit loss and charge exchange loss with neutrals make the radial electric field more negative than the value of purely neoclassical calculation. The partition of the injection energy among the shine through, direct orbit loss , charge exchange loss and bulk heating is estimated by using the self-consistent electric field profile. The power loss of fast ions caused by the orbit loss or charge exchange process is by a factor of several tens to hundred greater than the reduction of the energy loss of bulk ions through the enhancement of radial electric field. Comparison with W7-A experiment is made, and the differences are discussed. (author).

7409 (NIFS-MEMO–3) **Proceedings of symposium on technology in laboratories.** National Inst. for Fusion Science, Nagoya (Japan). Aug 1991. 338p. (In Japanese). (CONF-9003335– : Symposium on Technology in Laboratories, Toki (Japan), 19-20 Mar 1990). Order Number DE93753276. Source: OSTI; NTIS; INIS.

The Symposium on Technology in Laboratories was held on March 19 and 20, 1991 at Toki-Bunka Plaza in Toki City, Gifu Prefecture, Japan. This symposium was hosted by National Institute for Fusion Science (NIFS). There were about 280 participants from many Japanese universities and laboratories, and from some Japanese industrial world. Eighty papers were presented in the symposium. Technical experience and new techniques were reported and discussed being divided into five sessions; technologies of fabrication, cryogenics, diagnostic and control system, computer and experimental apparatus. (author).

7410 (NIFS-MEMO–6) **Development of high power microwave source.** Ono, Shoichi (Tohoku Univ., Sendai (Japan). Research Inst. of Electrical Communication). National Inst. for Fusion Science, Nagoya (Japan). Apr 1992. 42p. (In Japanese). Order Number DE93753316. Source: OSTI; NTIS; INIS.

To achieve thermonuclear fusion it is inevitable to develop high power microwave and millimeter wave sources for plasma heating. In 1990, working group was organized as a collaboration study in National Institute for Fusion Science to review the present status of development on high microwave source. We report the review of development on high power klystron and gyrotron, FEL and microwave power source by REB. Development of high power klystron is almost finished except for cooling of the window, cavity and collector. As for the gyrotron oscillating with the whispering gallery mode one must overcome the same problem for CW operation. In the quasi-optical gyrotron, these is no special progress for increasing the frequency and efficiency. Though the experimental evidence on autoresonance in the development of peniotron is performed, output power and frequency is much smaller than that of the gyrotron. It is difficult to increase in the pluse width of FEL having giant of GW level with several ten ns and the utilization for plasma heating is limited. In addition, we summarize microwave and millimeter wave oscillators with high power which are running in the laboratories and the institutes. (author).

7411 (ORNL/TM–12047) **A carbon-carbon composite materials development program for fusion energy applications.** Burchell, T.D. (Oak Ridge National Lab., TN (United States)); Eatherly, W.P.; Engle, G.B.; Hollenberg, G.W. Oak Ridge National Lab., TN (United States). Oct 1992. 59p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93003664. Source: OSTI; NTIS; INIS; GPO Dep.

Carbon-carbon composites increasingly are being used for plasma-facing component (PFC) applications in magnetic-confinement plasma-fusion devices. They offer substantial advantages such as enhanced physical and mechanical properties and superior thermal shock resistance compared to the previously favored bulk graphite. Next-generation plasma-fusion reactors, such as the International Thermonuclear Experimental Reactor (ITER) and the Burning Plasma Experiment (BPX), will require advanced carbon-carbon composites possessing extremely high thermal conductivity to manage the anticipated extreme thermal heat loads. This report outlines a program that will facilitate the development of advanced carbon-carbon composites specifically tailored to meet the requirements of ITER and BPX. A strategy for developing the necessary associated design data base is described. Materials property needs, i.e., high thermal conductivity, radiation stability, tritium retention, etc., are assessed and prioritized through a

systems analysis of the functional, operational, and component requirements for plasma-facing applications. The current Department of Energy (DOE) Office of Fusion Energy Program on carbon-carbon composites is summarized. Realistic property goals are set based upon our current understanding. The architectures of candidate PFC carbon-carbon composite materials are outlined, and architectural features considered desirable for maximum irradiation stability are described. The European and Japanese carbon-carbon composite development and irradiation programs are described. The Working Group conclusions and recommendations are listed. It is recommended that developmental carbon-carbon composite materials from the commercial sector be procured via request for proposal/request for quotation (RFP/RFQ) as soon as possible.

7412 (PPPL–2871) **Data-sharing protocol: A prototype implementation.** Gibney, T.; Greenwood, D. Princeton Univ., NJ (United States). Plasma Physics Lab. Dec 1992. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03073. Order Number DE93005729. Source: OSTI; NTIS; INIS; GPO Dep.

This paper describes a client/server communication protocol which will allow physicists to access data from cooperating remote experiments. Special low-level "client" software within the user's "home" data-access library formulates a request for data from the remote experiment. This request is sent over a network to a server at the remote site. The server has specific knowledge about the location and format of the requested data. The server gets the data and sends it over the network to the requesting client, which reformats the data according to the local library's conventions. Our prototype is being developed to suppose remote access to data from ATF, PBX, and micro Vax data from Tore-Supra. We have attempted to create a flexible design which should accommodate data from other experiments as well.

7413 (PSC–20) **Observation of a beam energy shift caused by a plasma wakefield.** Ogata, A. (National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan)); Enomoto, A.; Nakajima, K.; Nakanishi, H.; Suetsugu, Y.; Shoji, T.; Nishida, Y.; Yugami, N. Nagoya Univ. (Japan). Plasma Science Center. Jun 1992. 15p. Order Number DE93753243. Source: OSTI; NTIS; INIS.

The energy shifts of linac electron beams caused by a plasma wakefield were measured in plasmas with a density on the order of 10^{12} cm^{-3}. The linac provided a sequence of several bunches which generated a wakefield in the plasma. The wakefield, in turn, caused an energy change in the bunches. Data processing took account of the finite bunch length, which was comparable or even longer than the plasma wavelength. It shows that the observed wakefield, if converted into the values at the bunch center, amounted to $\approx$ 20 MeV/m in certain cases. The energy spectra were qualitatively consistent with the calculations. No buildup of the wakefield was obvious after the maximum bunch. (author).

7414 (UCRL-LR–105821-2) **Inertial Confinement Fusion quarterly report, January–March 1992: Volume 2, Number 2.** DeYoreo, J. (ed.). Lawrence Livermore National Lab., CA (United States). 1992. 56p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE93004825. Source: OSTI; NTIS; GPO Dep.

In this issue are discussed the following topics: Gain medium for laser-driven inertial fusion energy; plasma temperatures from LaNSA neutron time-of flight spectra; achromatism in final focusing systems for high-current heavy-ion beams; strongly coupled stimulated raman backscattering from subpicosecond laser-plasma interactions; three- dimensional simulation of light filamentation in laser-produced plasmas; and the effects of large x-ray fluences on x-ray multilayer mirrors.

99 GENERAL AND MISCELLANEOUS

7415 (ER-B–92-08) **Imprest fund at the US Department of Energy Pinellas Plant.** USDOE Office of Inspector General, Oak Ridge, TN (United States). Eastern Regional Audit Office. 11 Sep 1992. 12p. Sponsored by USDOE, Washington, DC (United States). Source: OSTI (Free of Charge).

Marietta Specialty Components Inc. (MMSC) succeeded General Electric Neutron Devices Department (GEND) June 1, 1992, as the managing and operating contractor of the Department of Energy's (DOE) Pinellas Plant, a multifunction facility in Pinellas County, Florida. The Pinellas Plant's mission includes fabrication and assembly of electronic, electromechanical, and mechanical components of nuclear weapons, approved reimbursable work for other Federal agencies, and development work on both products and processes. In carrying out its mission, GEND maintained a $25,000 imprest fund with annual activity of about $1.6 million. The purpose of the audit was to determine whether the imprest fund was operated in accordance with the contract and applicable regulations.

7416 (ETDE-mf–93744513) **Annual report '91 of the Water and Waste Management Authority of North-Rhine Westphalia.** Landesamt fuer Wasser und Abfall Nordrhein-Westfalen, Duesseldorf (Germany). Apr 1992 76p. (In German). Order Number DE93744513. Source: OSTI; NTIS (US Sales Only).

Waste disposal increasingly is in the focus of public interest. And for good reason: It is the touchstone for the future of our industrial society. The waste industry is at a crossroad: Well-known and innovative technologies are available, but lack of acceptance prevents the much needed landfills and treatment plants. Industry, trade and municipal authorities are being buried in waste. Enlightenment is necessary for more extensive waste avoidance and recycling and in order to bring about the necessary shift of opinion. In the annual report '91, much space is given to waste management topics. Thus, the use of residual products as construction materials, experience with the toxic waste management licence in North-Rhine-Westphalia, and the planned federal waste tax receive extensive coverage. Another important subject is underground storage of waste. (orig./BBR).

7417 (GSF-HY–1/92) **GSF Institute of Hydrology. Annual report 1991.** GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany). Inst. fuer Hydrologie. Apr 1992. 286p. (In German). Order Number DE93742814. Source: OSTI; NTIS (US Sales Only); INIS.

Investigations of the groundwater motion and the pollutant transport in the aquatic environment, including mathematical modelling are the center of emphasis of the report. Behavior was studied of selected herbicides (therbuthylazine) and heavy metals (Pb, Cd) as well as of arsenic, for example the isotope composition of sulfate in precipitation and in the soil was examined. The danger to Malm karst water through anthropogenic influences is discussed in the same way as a gravitation example of problems of shore filtration. New results of isotope investigations both in plant material and in Antarctic snow and ice are presented. (orig./BBR).

9901 Management

Refer also to citation(s) 5157, 5406, 5744, 6272, 6273, 6792, 7457, 7507

7418 (CONF-9206182–) **Department of Energy records management conference: Proceedings.** USDOE Office of Administration and Human Resource Management, Washington, DC (United States). Office of Information Resources Management Policy, Plans, and Oversight. [1992]. 448p. Sponsored by USDOE, Washington, DC (United States). From Department of Energy (DOE) records management conference; Denver, CO (United States); 23-25 Jun 1992. Order Number DE93002696. Source: OSTI; NTIS; GPO Dep.

These proceedings present ideas on the successful management of information for the US DOE. Records management for research and development, and management information is evaluated. The purpose of, requirements for, and responsibilities related to information management are discussed. Automation, recovery of lost records, and training are other topics that are considered.

7419 (CONF-920828–23) **The context and organization of demand-side management collaboratives: An overview.** Schweitzer, M. (Oak Ridge National Lab., TN (United States)); Raab, J. Oak Ridge National Lab., TN (United States). Sep 1992. 16p. Sponsored by USDOE, Washington, DC (United States). DOE

Contract AC05-84OR21400. From American Council for an Energy-Efficient Economy (ACEEE) summer study on energy efficiency in buildings; Pacific Grove, CA (United States); 30 Aug - 5 sep 1992. Order Number DE93003606. Source: OSTI; NTIS; GPO Dep.

Since 1988, a new approach to reaching agreement on Demand-Side Management (DSM) program design and policies has been tried by many utilities and nonutility parties (such as consumer advocates, environmental groups, and state energy offices,) across the country. This new approach, called a DSM collaborative process, attempts to reach consensus among oftentimes adversarial parties rather than using traditional litigation alone to resolve differences. This paper describes key contextual and organizational characteristics of collaboratives, using data collected during a recent study of nine cases of DSM collaboration involving 24 utilities and approximately 50 nonutility parties (NUPs) in 10 states. A lengthier report presents the full breadth of findings from that study, including a detailed analysis of the successes and failures of the collaboratives. Based on a review of the relevant literatures on Integrated Resource Planning and dispute resolution and on the authors' experience, four categories of contextual and organizational variables were chosen for study: (1) the regulatory and legal history of the collaborative: (2) the parties involved and those excluded. (3) the scope of the collaborative; and (4) the collaborative process. Regulatory and legal history includes the factors leading to initiation of the collaborative and the historic ability of different participating parties to influence the decisions made by state Public Utility Commissions (PUCs). Key characteristics of the parties involved and excluded include the types of participants, their expectations and willingness to compromise, and the attributes of those who did not participate. Under the topic of scope, the focus was on overall collaborative goals and on kev issues tackled bv the collaborative. Finally, the variables selected in the process arena include organizational structure, the use of outside consultants, and the use of consensus.

7420 (CONF-9211120–1) **Technology and the 21st Century government organization.** Tonn, B.E.; Bronzini, M.S.; Goeltz, R.T.; Hilliard, M.; Irby, M. Oak Ridge National Lab., TN (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 5. advanced technology conference of the United States Postal Service (USPS); Washington, DC (United States); 30 Nov - 2 dec 1992. Order Number DE93002506. Source: OSTI; NTIS; GPO Dep.

This paper presents a conceptual design for the 21st Century government organization. This design is applicable to the future US Postal Service and generalizable to other large government agencies. The design is based on conjectures in three areas: capabilities of information technology in the early 21st Century; motivations, needs, strengths, and weaknesses of members of the 21st Century workforce; and needs of large public organizations. The design addresses topics such as coordination, career tracks, communications, and the seamless integration of information resources.

7421 (DOE/NP/00119–1) **Research and Development of post-classical management tools for government program offices: First technical progress report, November 19, 1990–November 18, 1991.** Virginia Polytechnic Inst. and State Univ., Blacksburg, VA (United States). Management Systems Labs. May 1991. 71p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91NP00119. Order Number DE93005327. Source: OSTI; NTIS (US Sales Only); GPO Dep.

To reduce and control the uncertainties in their domains, managers must integrate comprehensive information using tools and methods developed to meet the needs of a new management approach and demonstrated in a real-world setting. Researching and developing these tools and methods is the objective of this research.

7422 (DOE/RL–91-36-Rev.1) **Standard review plan for Environmental Restoration program Quality Assurance Management Plans: Revision 1.** Cote, R.F. USDOE Richland Field Office, WA (United States). 31 Aug 1992. 217p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93002052. Source: OSTI; NTIS; INIS; GPO Dep.

This standard review plan (SRP) establishes both the scope of the review and the acceptance criteria to be used for the review of Quality Assurance Management Plans (QAMP) developed in accordance with the requirements of the US Department of Energy (DOE), Richland Field Office (RL), document DOE/RL-90-28. The DOE/RL-90-28, the Environmental Restoration Program Quality Assurance System Requirements for the Hanford Site (DOE-RL 1992), defines all quality assurance (QA) requirements governing activities that affect the quality of tho Environmental Restoration (ER) program at the Hanford Site. These requirements are defined in three parts: Part I, Quality Management and Administration; Part II, Environmental Data Operations; and Part III, Design and Control of Items and Engineered Environmental Systems. The purpose of this document is to identify the scope of the review by the RL staff, and establish the acceptance criteria (Parts I, II, and III) that the RL staff will use to evaluate the participant QAMPs. Use of the SRP will help ensure that participant QAMPs contain the information required by DOE/RL-90-28, aid the program participant and RL staff in ensuring that the information describing the participant's QAMP is complete, help persons reading-DOE/RL-90-28 to locate information, and contribute to decreasing the time needed for the review process. In addition, the SRP ensures the quality and uniformity of the staff reviews and presents a well-defined base from which to evaluate compliance of participant quality programs against DOE/RL-90-28.

7423 (ER-B–92-07) **Use of Government supply sources at the Savannah River Site.** USDOE Office of Inspector General, Oak Ridge, TN (United States). Eastern Regional Audit Office. 10 Aug 1992. 23p. Sponsored by USDOE, Washington, DC (United States). Source: OSTI (Free of Charge).

The purpose of the audit described in this report was to evaluate Westinghouse Savannah River Company's (WSRC) use of Government supply sources. The objective of the audit was to these sources were available, economically advantageous, or otherwise in the Government's best interest. Results of the audit are given.

7424 (IA–1471) **Research laboratories annual report 1991.** Israel Atomic Energy Commission, Tel Aviv (Israel). Aug 1992. [247] Order Number DE93609217. Source: OSTI; NTIS (US Sales Only); INIS.

The 1990-1991 activities, of the Israel Atomic Energy Commission's research laboratories, are presented in this report. The main fields of interest are chemistry and material sciences, life and environmental sciences, nuclear physics and technology.

7425 (INIS-BR–3082) **Program of nuclear techniques application (triennial 88-89-90).** Instituto de Pesquisas Energeticas e Nucleares (IPEN), Sao Paulo, SP (Brazil). 1988[112] (In Portuguese). Order Number DE93609822. Source: OSTI; NTIS (US Sales Only); INIS.

A real analysis of the potentiality and the possibility from Nuclear Energetic Research Institute (IPEN) Sao Paulo, Brazil in realize the researches and developments for offering specialized services of nuclear techniques for using in bioengineering, industry, isotope production, IEA-R1 reactor irradiation and radiation detectors and sensors are described. (author).

7426 (INIS-GB–456) **Report and accounts 1991-92.** Nuclear Electric plc, Barnwood (United Kingdom). 1992[60] Order Number DE93609823. Source: OSTI; NTIS (US Sales Only); INIS.

In the second full year of operation, Nuclear Electric has improved its competitive position and increased operating profits are recorded. The long-term aim is to be profitable without the fossil-fuel levy. The operating record of Nuclear Electric's Magnox and AGR power stations, progress on Sizewell-B and the decommissioning of Berkeley Station are recorded. The year 1991/92 is reviewed; the commercial, production and fuel operations are reported. Health and Safety - a main priority of Nuclear Electric is considered and Nuclear Electric's environmental policy is stated. Human resources, public relations and international affairs are covered. A statistical summary including the accounts is included. (UK).

7427 (INIS-mf–14089) **Research and development at Kernforschungszentrum Karlsruhe - brief report 1991.** Kernforschungszentrum Karlsruhe GmbH (Germany). 1992 44p. (In German). Order Number DE93744412. Source: OSTI; NTIS (US Sales Only); INIS.

Research at Kernforschungszentrum Karlsruhe in the nineties is focussed on environmentally compatible high technologies with emphasis on environmental engineering, power engineering, microsystems technology, and selected fields of fundamental research. The KfK research and development trends are reflected by this brief report. The facts and figures inform researchers and specialists by summarizing the major results of the current research projects and by informing about the main targets and trends of long-time research programs and individual projects. The brief reports are completed by comprehensive, annual progress reports which discuss the implementation and results of the KfK research activities and compile references which list the various scientifico-technical reports, contributions to journals, conference papers, and other publications. (orig.).

7428 (INIS-mf–14090) **Research and development at Kernforschungszentrum Karlsruhe - progress report 1991.** Kernforschungszentrum Karlsruhe GmbH (Germany). 14 May 1992 461p. (In German). Order Number DE93744411. Source: OSTI; NTIS (US Sales Only); INIS.

The Kernforschungszentrum Karlsruhe progress report is the 1991 issue of the scientific reports the institution is bound to submitt each year according to para. 13.4 of its articles of partnership. The points of main effort which are discussed reflect the institution's R and D scheme. The summaries submitted by the different institutes and departments are compiled by the topics and fields they deal with. The report gives an account of the progress under each of the KfK R and D projects. This correlation facilitates comparisons between the targets and actual achievements and elucidates the general relation between the individual tasks which often are in the care of several institutes at a time. The departments and institutes and their respective tasks are introduced, and a comprehensive appendix is attached which lists the 1991 publications. (orig./UA).

7429 (PNL-SA–21253) **Continuous improvement on a research and development environment.** Hood, F.C. Pacific Northwest Lab., Richland, WA (United States). Sep 1992. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9209141–4: 19. annual American Society for Quality Control (ASQC) National Energy Division conference, Orlando, FL (United States), 20-23 Sep 1992). Order Number DE93001561. Source: OSTI; NTIS; GPO Dep.

At Pacific Northwest Laboratory (PNL), continuous improvement (CI) concepts are integrated into research and development (R&D) program and project management. Major management initiatives have been established to promote cultural acceptance of CI and foster a working environment for excellence. Laboratory management are committed to CI tailored to specific R&D, functional, and staff needs to ensure PNL's integrated management system provides the means to quality in performance and customer satisfaction. Continuous improvement philosophy applies to R&D as well as more conventional engineering and administrative activities. It is a value-added process for excellence and success.

7430 (RCNP-P–121) **Reports on the utilization of the grant-in-aid for computational programs (the fiscal year 1991).** Osaka Univ., Ibaraki (Japan). Research Center for Nuclear Physics. Jun 1992. 175p. (In Japanese, English). Order Number DE93753382. Source: OSTI; NTIS; INIS.

In the Research Center for Nuclear Physics, Osaka University, as a part of the joint utilization activities, the expenses for computation in joint utilization have been provided since 1976, and have supported the (mainly theoretical) numerical calculation in the field of nuclear physics. As for these expenses for computation, the subjects of 50,000 yen or more are collected every year, and by the opinion of the referees and through the discussion of the ad hoc committee, subjects are adopted. When these expenses are used, after finishing the use, the simple report of definite form and the detailed report regarding the contents of computation are to be submitted. The former includes the period of computation, the expense of computation, the publication of results, the summary of main results and so on. In the latter report, English abstract, the results obtained by computation and the explanation of physical contents, the new development of computation technology, difficulty and the method of its solution, the subroutines and functions used for computation and their functions, block diagrams and so on are included. In this book, 28 latter reports of the use in fiscal year 1991 are collected. (K.I.).

7431 (SAND–92-2445C) **How false starts, redirection, and major interruptions impact TQM efforts (or, surviving real life).** Poteat, T. Sandia National Labs., Albuquerque, NM (United States). [1992]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9211138–1: U.S. Army COE Research Labatories annual executive manager's conference, Champagne, IL (United States), 3 Nov 1992). Order Number DE93004051. Source: OSTI; NTIS; GPO Dep.

Short communication. SANDIA LABORATORIES/management; QUALITY ASSURANCE; MANAGEMENT; PLANNING; PROGRAM MANAGEMENT; PERSONNEL MANAGEMENT

7432 (UCRL-JC–111311) **Making the transition to ANSI/ASQC E4.** Wolfe, D.W. Lawrence Livermore National Lab., CA (United States). Jul 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9209141–3: 19. annual American Society for Quality Control (ASQC) National Energy Division conference, Orlando, FL (United States), 20-23 Sep 1992). Order Number DE93001302. Source: OSTI; NTIS; INIS; GPO Dep.

As ANSI/ASQC E4, Quality Systems Requirements for Environmental Programs, nears final form and formal issuance by the American National Standards Institute (ANSI) and the American Society for Quality Control (ASQC), numerous organizations will be developing and implementing quality assurance programs based on the criteria promulgated by ANSI/ASQC E4. The organizations to initially adopt ANSI/ASQC E4 will be those that already have quality assurance programs based either on ASME NQA^{-1} or EPA QAMS-005/8. This paper presents the changes/enhancements required to transition an ASME NQA^{-1} or EPA QAMS-005/80 based quality assurance program to a program which meets the requirements of ANSI/ASQC E4.

7433 (UTNL-R–0279) **Annual report of Nuclear Engineering Research Laboratory, University of Tokyo in fiscal 1991.** Tokyo Univ., Tokai, Ibaraki (Japan). Nuclear Engineering Research Lab. Jul 1992. 78p. (In Japanese). Order Number DE93753404. Source: OSTI; NTIS; INIS.

In this annual report, the activities of education and research, the state of operation of research facilities and others in Nuclear Engineering Research Laboratory, University of Tokyo in fiscal year 1991 are summarized. In this Laboratory, there are four large research facilities, that is, the fast neutron source reactor 'Yayoi', the electron beam linac, the nuclear fusion reactor blanket experiment facility and the heavy irradiation research facility. Those are used for carrying out education and research in the wide fields of nuclear engineering, and are offered also for joint utilization. The results of the research by using respective research facilities were summarized in separate reports. In this annual report, the course of the management and operation of respective research facilities is described, and the research activities, the theses for doctorate and graduation theses of the teachers, personnel and graduate students in the Laboratory are summarized. In the research, those on first wall engineering for fusion reactors, fuel cycle engineering, electromagnetic structure engineering, AI and robotics, quantum beam engineering, new type reactor design and so on are included. (K.I.).

7434 (UTNL-R–0280) **Report of the research results with University of Tokyo, Nuclear Engineering Research Laboratory's Facilities in fiscal 1991.** Tokyo Univ., Tokai, Ibaraki (Japan). Nuclear Engineering Research Lab. 1992. 146p. (In Japanese). Order Number DE93753403. Source: OSTI; NTIS; INIS.

This publication summarizes the results of the joint utilization of the nuclear reactor 'Yayoi' and the electron beam accelerator in the Nuclear Engineering Research Laboratory, University of Tokyo, in fiscal year 1991. The Yayoi was operated smoothly throughout the year, and the number of research themes, for which the reactor

Yayoi was jointly utilized, and the related themes reached 21 cases. After the linear accelerator was reconstructed as the twin linac, the joint utilization was resumed in October, 1989, and the number of research themes, was 15 cases. In this publication, in addition to the utilization reports, also the reports of 15 cases of Yayoi Study Meetings held in fiscal year 1991 are collected. (K.I.).

7435 (UTRCN-G–21) **Report on progress of researches by common utilization of JAERI nuclear facilities, for fiscal, 1991.** Tokyo Univ. (Japan). Research Center for Nuclear Science and Technology. Aug 1992. 482p. (In Japanese, English). Order Number DE93754373. Source: OSTI; NTIS; INIS.

The results of the joint researches by utilizing the facilities of JAERI in 1991 fiscal year were summarized, and this report was able to be completed. Many researchers in whole Japan took part in many themes, and the very significant results were obtained. Now this joint research has reached the great turnabout period. The reconstructed JRR-3M was offered for joint utilization since April, 1991, and the utilization for neutron diffraction and scattering increased largely. As for the ion irradiation facility in Takasaki Research Establishment, the partial operation will be started in the next year, and the joint utilization is expected to begin. Accompanying the diversification of the utilization of facilities, in order to properly meet the needs of users, the thorough revision of the system seems necessary. The number of research themes in 1991 was 222 cases. JRR-3M accomplished the joint utilization operation of 8 cycles as expected, but JRR-2 caused a trouble during 5th cycle, and the operation thereafter was canceled. In this book, 159 reports are collected. (K.I.).

7436 (WHC-SP–0708) **Westinghouse Hanford Company Conduct of Operations Manual: GOCO Cross-Cultivation Committee, Operational Excellence Task Force.** Schilperoort, D. Westinghouse Hanford Co., Richland, WA (United States). Nov 1991. 174p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93001664. Source: OSTI; NTIS; GPO Dep.

This manual has been prepared to establish guidelines that are to be used at all Westinghouse Government Operations Business Unit (GOBU) sites and Westinghouse Savannah River Company (WSRC). The purpose of the manual is to establish standards that comply with the requirements of Department of Energy (DOE) Order 5480.19, "Conduct of Operations Requirements for DOE Facilities" and that will be used at all Westinghouse Government Operations Business Unit sites and Westinghouse Savannah River Company.

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Refer also to citation(s) 5023, 5065, 5066, 5168, 5171, 5195, 5207, 5227, 5258, 5260, 5273, 5333, 5347, 5348, 5444, 5446, 5447, 5448, 5460, 5465, 5466, 5467, 5468, 5469, 5470, 5492, 5604, 5606, 5607, 5608, 5609, 5610, 5611, 5638, 5640, 5646, 5647, 5648, 5653, 5654, 5660, 5666, 5671, 5681, 5748, 5807, 5822, 5866, 5867, 5868, 5870, 5871, 5872, 5873, 5879, 5880, 5881, 5882, 5883, 5885, 5909, 5939, 5980, 6190, 6196, 6200, 6201, 6202, 6204, 6211, 6212, 6214, 6216, 6218, 6221, 6222, 6223, 6225, 6231, 6242, 6251, 6295, 6317, 6326, 6327, 6328, 6354, 6355, 6363, 6384, 6385, 6394, 6399, 6410, 6444, 6445, 6456, 6461, 6463, 6652, 6838, 6839, 6848, 6850, 6857, 6898, 6903, 6983, 6984, 7016, 7017, 7043, 7051, 7083, 7136, 7142, 7170, 7382, 7412, 7507, 7511

7437 (ANL/CP–77460) **A hyperspectral image analysis workbench for environmental science applications.** Christiansen, J.H.; Zawada, D.G.; Simunich, K.L.; Slater, J.C. Argonne National Lab., IL (United States). [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-930141–1: 9. international conference on interactive information and processing, Anaheim, CA (United States), 17-22 Jan 1993). Order Number DE93000603. Source: OSTI; NTIS; GPO Dep.

A significant challenge to the information sciences is to provide more powerful and accessible means to exploit the enormous wealth of data available from high-resolution imaging spectrometry, or "hyperspectral" imagery, for analysis, for mapping purposes, and for input to environmental modeling applications. As an initial response to this challenge, Argonne's Advanced Computer Applications Center has developed a workstation-based prototype software workbench which employs AI techniques and other advanced approaches to deduce surface characteristics and extract features from the hyperspectral images. Among its current capabilities, the prototype system can classify pixels by abstract surface type. The classification process employs neural network analysis of inputs which include pixel spectra and a variety of processed image metrics, including image "texture spectra" derived from fractal signatures computed for subimage tiles at each wavelength.

7438 (ANL/CP–77516) **Solution of large, sparse systems of linear equations in massively parallel applications.** Jones, M.T.; Plassmann, P.E. Argonne National Lab., IL (United States). [1992]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-921125–5: ACM/IEEE supercomputing conference, Minneapolis, MN (United States), 14-21 Nov 1992). Order Number DE93004243. Source: OSTI; NTIS; GPO Dep.

We present a general-purpose parallel iterative solver for large, sparse systems of linear equations. This solver is used in two applications, a piezoelectric crystal vibration problem and a superconductor model, that could be solved only on the largest available massively parallel machine. Results obtained on the Intel DELTA show computational rates of up to 3.25 gigaflops for these applications.

7439 (ANL/MCS-TM–163) **Extending compile-time reverse mode and exploiting partial separability in ADIFOR: ADIFOR Working Note No. 7.** Bischof, C.H.; El-Khadiri, M. Argonne National Lab., IL (United States). Mathematics and Computer Science Div. Oct 1992. 43p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE93004668. Source: OSTI; NTIS; GPO Dep.

The numerical methods employed in the solution of many scientific computing problems require the computation of the gradient of a function f: $R^n \rightarrow R$. ADIFOR is a source translator that, given a collection of subroutines to compute f, generates Fortran 77 code for computing the derivative of this function. Using the so-called torsion problem from the MINPACK-2 test collection as an example, this paper explores two issues in automatic differentiation: the efficient computation of derivatives for partial separable functions and the use of the compile-time reverse mode for the generation of derivatives. We show that orders of magnitudes of improvement are possible when exploiting partial separability and maximizing use of the reverse mode.

7440 (ANL/MSD/CP–77613) **Pass or fail: A new test for password legitimacy.** Cherry, A.; Henderson, M.W.; Nickless, W.K.; Olson, R.; Rackow, G. Argonne National Lab., IL (United States). 25 Sep 1992. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9210216–1: Sequent users' resource forum, Atlanta, GA (United States), 26-28 Oct 1992). Order Number DE93002979. Source: OSTI; NTIS; GPO Dep.

While other programs check for bad passwords after the fact, it in important to have good passwords at all times, not just after the latest Crack run. To this end we have modified Larry Wall's Perl password program and added, among other features, the ability to check a sorted list of all the "bad passwords" that Crack will generate, given all the dictionaries that we could get our hands on (107 MB of unique words, so far). The combination of improvements has turned publicly available code into a powerful tool that can aid sites in the maintenance of local security.

7441 (BNL–47929) **Power to detect normal mixtures: Simulation results.** Thode, H.C. Jr. Brookhaven National Lab., Upton, NY (United States). 22 Jul 1992. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. Order Number DE93003143. Source: OSTI; NTIS; GPO Dep.

Twenty tests for normality were compared for the purpose of detecting mixtures of two normal components with unequal means but equal variance. The purpose of this study was to determine the power of tests specifically designed to detect mixtures, i.e., the

likelihood ratio and Engelman-Hartigan tests, relative to other tests for normality. We considered the entire range of mixing proportions π, $0 < \pi < 1$. For mixtures that are nearly symmetric ($0.35 < \pi < 0.65$) the Engelman-Hartigan test was the most powerful. When $\pi > 0.85$ or $\pi < 0.15$, $\sqrt{b_1}$ was among the best tests. For intermediate mixing proportions, the likelihood ratio test was best. For situations in which the preferred test had power 50% or more, the power of the likelihood ratio test was also above 50% and within 15 percentage points of the preferred test.

7442 (CDTN-DERL-NT–001/89) **SEVERO code - user's manual.** Sacramento, A.M. do. Centro de Desenvolvimento da Tecnologia Nuclear (CDTN), Belo Horizonte, MG (Brazil). 1989. [21] (In Portuguese). Order Number DE93609810. Source: OSTI; NTIS (US Sales Only); INIS.

This user's manual contains all the necessary information concerning the use of SEVERO code. This computer code is related to the statistics of extremes = extreme winds, extreme precipitation and flooding hazard risk analysis. (A.C.A.S.).

7443 (CONF-9110197–3) **Automated knowledge acquisition for second generation knowledge base systems: A conceptual analysis and taxonomy.** Kotnour, T.; Williams, K. Virginia Polytechnic Inst. and State Univ., Blacksburg, VA (United States). Management Systems Labs. [1991]. 8p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract FG02-91NP00119. Contract N00014-91-J-1500. (CONF-9110444–1: American Society for Engineering Management annual conference; 27. annual meeting of the Institute of Management Sciences, Chattanooga, TN (United States); Myrtle Beach, SC (United States), 20-22 Oct 1991; 3-4 oct 1991). Order Number DE93004151. Source: OSTI; NTIS (US Sales Only); GPO Dep.

In this paper, we present a conceptual analysis of knowledge-base development methodologies. The purpose of this research is to help overcome the high cost and lack of efficiency in developing knowledge base representations for artificial intelligence applications. To accomplish this purpose, we analyzed the available methodologies and developed a knowledge-base development methodology taxonomy. A set of developed characteristics allows description and comparison among the methodologies. We present the results of this conceptual analysis of methodologies and recommendations for development of more efficient and effective tools.

7444 (CONF-9110404–2) **Predicting structure in nonsymmetric sparse matrix factorizations.** Gilbert, J.R. (Xerox Palo Alto Research Center, CA (United States)); Ng, E. Oak Ridge National Lab., TN (United States). [1991]. 36p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract AC05-84OR21400. From IMA workshop on sparse matrix computations: graph theory issues and algorithms; Minneapolis, MN (United States); 14-18 Oct 1991. Order Number DE93004119. Source: OSTI; NTIS; GPO Dep.

Many computations on sparse matrices have a phase that predicts the nonzero structure of the output, followed by a phase that actually performs the numerical computation. We study structure prediction for computations that involve nonsymmetric row and column permutations and nonsymmetric or non-square matrices. Our tools are bipartite graphs, matchings, and alternating paths. Our main new result concerns LU factorization with partial pivoting. We show that if a square matrix A has the strong Hall property (i.e., is fully indecomposable) then an upper bound due to George and Ng on the nonzero structure of L + U is as tight as possible. To show this, we prove a crucial result about alternating paths in strong Hall graphs. The alternating-paths theorem seems to be of independent interest: it can also be used to prove related results about structure prediction for QR factorization that are due to Coleman, Edenbrandt, Gilbert, Hare, Johnson, Olesky, Pothen, and van den Driessche.

7445 (CONF-9111236–, pp. 82-85) **The XUMA expert system. A tool for the assessment of contaminated sites.** Geiger, W. (Kernforschungszentrum Karlsruhe GmbH (KfK) (Germany)); Jaeschke, A.; Osterkamp, G.; Reissfelder, M.; Weidemann, R. Arbeitsgemeinschaft der Grossforschungseinrichtungen (AGF), Bonn (Germany). 1991. 86p. (In German). From AGF meeting on ground pollution and water pollution: Stocktaking - carryover - redevelopment approaches; Bonn (Germany); 28-29 Nov 1991. In *Soil and water pollution*. Order Number DE93742729. Source: OSTI; NTIS (US Sales Only).

In the state of Baden-Wuerttemberg, the regional water resources offices and the State Institute for Environmental Protection (LfU) as the central authority are in charge of the assessment of contaminated sites. Within the framework of a joint research project of the Karlsruhe Nuclear Research Center and the LfU, the XUMA expert system for the assessment of contaminated sites is being developed. XUMA is to support the officials working at these authorities. By means of the system, the domain knowledge of the few specialists working in this field is made available to the officials in charge and the latter are relieved in their routine work. Moreover, XUMA is supposed to standardize the assessment procedure and to make the assessments objective and reproducible. The system serves to support the officials in charge when assessing the contaminated sites in a first estimation, preparing the analysis plans and evaluating the analytical results. An explanation facility helps the user to trace back the conclusions derived by the system. In addition, a knowledge acquisition facility is available for the input of new experiences into the knowledge base by the specialists themselves. Since June 1990, a prototype of the system has been tested at the LfU. (orig.).

7446 (CONF-920368–1) **Analysis of complex systems using neural networks.** Uhrig, R.E. (Tennessee Univ., Knoxville, TN (United States). Dept. of Nuclear Engineering). Tennessee Univ., Knoxville, TN (United States). Dept. of Nuclear Engineering; Oak Ridge National Lab., TN (United States). [1992]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG07-88ER12824. From 2. international forum on expert systems and computer simulation in energy engineering; Erlangen (Germany); 17-21 Mar 1992. Order Number DE93003541. Source: OSTI; NTIS; INIS; GPO Dep.

The application of neural networks, alone or in conjunction with other advanced technologies (expert systems, fuzzy logic, and/or genetic algorithms), to some of the problems of complex engineering systems has the potential to enhance the safety, reliability, and operability of these systems. Typically, the measured variables from the systems are analog variables that must be sampled and normalized to expected peak values before they are introduced into neural networks. Often data must be processed to put it into a form more acceptable to the neural network (e.g., a fast Fourier transformation of the time-series data to produce a spectral plot of the data). Specific applications described include: (1) Diagnostics: State of the Plant (2) Hybrid System for Transient Identification, (3) Sensor Validation, (4) Plant-Wide Monitoring, (5) Monitoring of Performance and Efficiency, and (6) Analysis of Vibrations. Although specific examples described deal with nuclear power plants or their subsystems, the techniques described can be applied to a wide variety of complex engineering systems.

7447 (CONF-920538–28) **Neural networks for the monitoring of rotating machinery.** Alguindigue, I.E. (Tennessee Univ., Knoxville, TN (United States). Dept. of Nuclear Engineering); Loskiewicz-Buczak; Uhrig, R.E. Tennessee Univ., Knoxville, TN (United States). Dept. of Nuclear Engineering; Oak Ridge National Lab., TN (United States). [1991]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG07-88ER12824 ;AC05-84OR21400. From 8. power plant dynamics, control and testing symposium; Knoxville, TN (United States); 27-29 May 1992. Order Number DE93003549. Source: OSTI; NTIS; INIS; GPO Dep.

Vibration monitoring of components in engineering systems and plants involves the collection of vibration data and detailed analysis to detect features which reflect the operational state of the machinery. The analysis leads to the identification of potential failures and their causes, and makes it possible to perform efficient preventive maintenance. This paper describes a methodology for the automation of some of the activities related to motion and vibration monitoring in these systems. The technique involves training a neural network to model the inter- relationship between signals from two related sensors mounted on an engineering system or component at a time when it is known to be operating properly. Then one signal (or its characteristics) is put into the neural network model to

predict the second signal (or its characteristics). This predicted signal is continuously compared with the actual signal A deviation between the predicted and actual signal indicates a changing relationship, usually failure of the component or system. This deviation may be quantified and provides meaningful information about the degree of degradation and deterioration of the component.

7448 (CONF-9208176–1) **HModel: An X tool for global model search.** Ostrouchov, G. Oak Ridge National Lab., TN (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 10. symposium on computational statistics; Neuchatel (Switzerland); 23-28 Aug 1992. Order Number DE93002826. Source: OSTI; NTIS; GPO Dep.

HModel is a global model search tool that has X window graphics capability. The user defines the largest generalized polynomial model to consider, HModel generates the collection of all smaller hierarchical models that it contains and displays a graphical representation of the collection. Then, given a model optimality criterion threshold HModel finds all models that are at least as good. That is, HModel classifies all models into two groups: those at or below the threshold and those above the threshold. If the set of models at least as good as the threshold is small, finding this set requires fitting only a small fraction of all models. The selection of models to fit can be automatic or conveniently controlled by the user. A search string facility for selecting sets of models as well as other set operations are also available. All of these functions interact with the graphical representation of the collection of models. The current implementation and this paper focus on log-linear models for categorical data and the Akaike and Bayes information criteria although the underlying ideas are more general. The search can manipulate a collection of up to about 200,000 models on a high performance workstation. For example, six categorical variables give 140.035 possible models of order three or less.

7449 (CONF-9209274–1) **The design of scalable software libraries for distributed memory concurrent computers.** Choi, Jaeyoung (Oak Ridge National Lab., TN (United States)); Walker, D.W.; Dongarra, J.J. Oak Ridge National Lab., TN (United States). [1992]. 14p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract AC05-84OR21400. Contract DAAL03-91-C-0047. From CNRS-NSF collaboration workshop on environments and tools for parallel scientific computing; St. Hilaire du Touvet (France); 7-8 Sep 1992. Order Number DE93003612. Source: OSTI; NTIS; GPO Dep.

This paper describes the design of ScaLAPACK, a scalable software library for performing dense and banded linear algebra computations on distributed memory concurrent computers. The specification of the data distribution has important consequences for interprocessor communication and load balance, and hence is a major factor in determining performance and scalability of the library routines. The block scattered data distribution is adopted as a simple, yet general-purpose, way of decomposing block-partitioned matrices. Distributed memory versions of the Level 3 BLAS provide an easy and convenient way of implementing the ScaLAPACK routines. Performance and scalability results for the ScaLAPACK LU factorization routine are presented, and potential uses for ScaLAPACK are discussed.

7450 (CONF-9209274–2) **Level 3 BLAS for distributed memory concurrent computers.** Choi, Jaeyoung (Oak Ridge National Lab., TN (United States)); Walker, D.W.; Dongarra, J.J. Oak Ridge National Lab., TN (United States). [1992]. 14p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract AC05-84OR21400. From CNRS-NSF collaboration workshop on environments and tools for parallel scientific computing; St. Hilaire du Touvet (France); 7-8 Sep 1992. Order Number DE93003613. Source: OSTI; NTIS; GPO Dep.

This paper discusses issues in developing a version of the Level 3 BLAS for distributed memory concurrent computers. The Level 3 BLAS are particularly important when using machines with hierarchical memory as they maximize reuse of data in the upper levels of the memory hierarchy. In implementing the distributed Level 3 BLAS a block scattered decomposition is employed. Details of the parallel implementation of DGEMM, for performing matrix-matrix multiplication, and DTRSM, for solving triangular systems, are given, and results are presented for runs on the Intel Touchstone Delta computer.

7451 (DOE/ER/25016–T1) **National Research Council Board on mathematical sciences: Annual report, July 15, 1987–July 14, 1988.** National Science Foundation, Washington, DC (United States). [1988]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI05-86ER25016. Order Number DE93005049. Source: OSTI; NTIS; GPO Dep.

The Board provides a locus of activity and concern at the National Research Council for issues affecting the mathematical sciences; represents the mathematical sciences to National Academy of Sciences (NAS); and provides a forum for the NAS, government agencies, and the mathematical sciences community. In 1986, the Board sponsored the first of an annual series of symposia in conjunction with National Science and Technology Week. The Board also began in cooperation with NRC Mathematical Sciences Education Board a comprehensive study of university mathematics concerns (MS 2000 Project). Other committees and colloquia are also discussed.

7452 (DOE/ER/25106–1-Vol.1) **Copper Mountain conference on iterative methods, Volume 1.** Front Range Scientific Computations, Inc., Boulder, CO (United States); Colorado Univ., Denver, CO (United States). [1992]. 378p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER25106. (CONF-920472–Vol.1: Copper Mountain conference on iterative methods, Copper Mountain, CO (United States), 9-16 Apr 1992). Order Number DE93004993. Source: OSTI; NTIS; GPO Dep.

Individual papers contained in this document indexed separately.

7453 (DOE/ER/25106–1-Vol.2) **Copper Mountain conference on iterative methods, Volume 2.** Front Range Scientific Computations, Inc., Boulder, CO (United States); Colorado Univ., Denver, CO (United States). [1992]. 380p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER25106. (CONF-920472–Vol.2: Copper Mountain conference on iterative methods, Copper Mountain, CO (United States), 9-16 Apr 1992). Order Number DE93004994. Source: OSTI; NTIS; GPO Dep.

Individual papers contained in this document indexed separately.

7454 (ESTSC–000312SUN0001) **TEMPEST/N33.5: Computational fld. dynamics package for incompressible, 3d, time dependent prob.** Trent, Dr.D.S. (Pacific Northwest Lab., Richland, WA (United States)); Eyler, Dr.L.L. Battelle-Northwest, Richland, WA (United States). Pacific Northwest Lab. 1 Apr 1991. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Source: ESTSC.

Description: SUN; MACHINE SPECIFIC UNICOS, UNIX, VFORTRAN; 2 3.5 Diskettes. TEMPESTN33.5 has been vectorized for use on Cray Research and Convex computers and adapted to the Digital Equipment Corporation and Control Data Corporation computers as well. Versions are also available for Apollo and Macintosh Workstations.

TEMPESTN33.5 provides numerical solutions to general incompressible flow problems with coupled heat transfer in fluids and solids. Turbulence is created with a k-e model and gas, liquid or solid constituents may be included with the bulk flow. Problems may be modeled in Cartesian or cylindrical coordinates. Limitations include incompressible flow, Boussinesq approximation, and passive constituents. No direct steady state solution is available; steady state is obtained as the limit of a transient.

7455 (ESTSC–000321IPCAT00) **AYER: 2-d finite element heat conduction.** Butler, J.W. (Butler Associates, Lemont, IL (United States)). Los Alamos National Lab., NM (United States). 1 May 1974. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (NESC–9564). Source: ESTSC.

Description: IBM PC/AT; DOS 3.1;3.2; RYAN MCFARLAND FORTRAN 2.4; 1 5.25 Diskette. Recommended optional software is the Professional FORTRAN Scientific Subroutine Library from Wiley Professional Software. The sample problem was taken from reference 3.

AYER is a finite element program which implicitly solves the general two-dimensional equation of thermal conduction for plane or axisymmetric bodies. AYER takes into account the effects of time (transient problems), in-plane anisotropic thermal conductivity, a three-dimensional velocity distribution, and interface thermal contact resistance. Geometry and material distributions are arbitrary, and input is via subroutines provided by the user. As a result, boundary conditions, material properties, velocity distributions, and internal power generation may be made functions of, e.g., time, temperature, location, and heat flux.

7456 (ESTSC–000424MNFRM00) **HILDA: Heavy Ion Linac Design Analysis code.** Close, E. (Lawrence Berkeley National Lab., CA (United States)); Fong, C.; Lee, E. Lawrence Berkeley Lab., CA (United States). 1 Oct 1991. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Source: ESTSC.

Description: MAINFRAMES; In principal any system which caFORTRAN; 3 3.5 diskettes. Sucessful operation strongly dependent on knowledgeable user interaction and data preparation. Not meant to a Black Box program. In its present state needs further user interface development, further model extensions.

HILDA is a program which estimates the cost and finds an optimal design for HIF induction linac drivers. It can model near-term machines as well as full-scale drivers. Code objectives are: (1) A relatively detailed, but easily understood model. (2) Modular, structured code to faciliate making changes in the model, the cost algorithm, program structure and generated reports.

7457 (ESTSC–000431IBMPC00) **ARTS: Accountability Reporting and Tracking System.** Jones, J.F. (EG and G Idaho Inc., Idaho Falls, ID (United States)); Faccio, R.M. EG and G Idaho, Inc., Idaho Falls, ID (United States). 1 Oct 1991. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Source: ESTSC.

Description: IBM PC; PC-DOS or MS-DOS, version 3.0 thdBASE IV, version 1.1; 1 3.5 diskette. This application requires that you own dBASE IV, version 1.1 or greater to execute. The application is designed to utilize a Hewlett Packard Laserjet printer, that is, HP Laserjet printer control string are hardcoded in the report modules. The application contains an employee database (table) refresh process that is designed to work off of an ASCII file that has been created and downloaded from an mainframe environment. The main or calling module is ART000.prg.

ARTS is a micro based prototype of the data elements, screens, and information processing rules that apply to the Accountability Reporting Program. The system focuses on the Accounability Event. The Accountability Event is an occurence of incurring avoidable costs. The system must be able to CRUD (Create, Retrieve, Update, Delete) instances of the Accountability Event. Additionally, the system must provide for a review comittee to update the 'event record' with findings and determination information. Lastly, the system must provide for financial representatives to perform a cost reporting process.

7458 (ESTSC–000435CY0MP00) **LK: Look at (search) large files.** Mullaney, J.E. (Westinghouse Hanford Company, Richland, WA (United States)). Westinghouse Hanford Co., Richland, WA (United States). 24 Dec 1991. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Source: ESTSC.

Description: CRAY X-MP; UNICOS 6.1; FORTRAN 77; 1 5.25 Diskette. The Fortran 77 program lk3. for needs to be compiled and loaded as lk3. The executable lk3 is invoked by the script lk. The script lk should be modified as needed by the user to define the path to lk3.

Scanning large files for information can be time consuming and expensive when using edit utilities on large mainframe computers. The reason is that editors must usually load the file into a buffer.

7459 (ESTSC–000444IPS0200) **CINDY1.2: Code for INternal DosimetrY.** Strenge, D.L. (Pacific Northwest Lab., Richland, WA (United States)); Kennedy, R.A.; Johnson, J.R.; Sula, M.J. Battelle-Northwest, Richland, WA (United States). Pacific Northwest Lab. 1 Jul 1992. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Source: ESTSC.

Description: IBM PS/2; DOS; FORTRAN AND QUICKBASIC; 2 3.5 Diskettes. Version 1.2 utilizes a sortware qualtiy assurance key to control access to features of CINDY. This key allows you to make an unlimited number of backup and/or demonstration copies of the software. The quality assurance key is a physical device that plugs into the first parallel printer port (LPT1) and is distributed with licensed copies of CINDY. The software quality assurance key must be installed on the host computer to access all of CINDY's features. If the key is not present, CINDY operates in a demonstration mode where most features, but not all, may be asscessed. Version 1.2 of CINDY operates successfully under PC-DOS and MS-DOS Version 3.3. PC-DOS Version 5.0 is recommended because memory resident code may reside in expanded memory, consequently allow...

CINDY was developed to assist in the interpretation of bioassay data, provide bioassay projections, and evaluate committed and calendar-year doses from intake or bioassay measurement data. CINDY addresses DOE Order 5480.11 and NRC 10 CFR 20 by providing the capabilities to calculate organ dose equivalents and effective dose equivalents using the International Commission on radiological Protection (ICRP) 30 approach. Biokinetic models are used to estimate intakes, estimate organ burdens, urinary and fecal excretion rates from a given intake, and determine organ doses for annual, 50-year, calendar year, or any other time point. Intakes may be either acute or chronic, and consist of many combinations of intake routes, radionuclides, and physical and chemical forms. A four compartment input model is used for wounds and absorption. Direct injection can be simulated as direct absorption. Appropriate megabolic models for each radionuclide are selected by the user from menus. Within the software package, intakes are handled as a collection of intake components where each component consists of a single exposure pathway, exposure duration, and radionuclide physical or chemical form. Determines the intake components for a given intake, based on user input describing the exposure, and on the bioassay data entered. The user may select any or all of these intake components for a given calculational run. Results are then summed over the selected intake components. The user interface anticipates the next logical action to occur and positions the cursor bar on that option. Menus stacking provides a road map of where the user is within the software. The user interface controls windows used for the display and entry of all input parameters. Results can be viewed in a screen window, printed, and saved to life.

7460 (ESTSC–000472I036000) **COMNUCCASCADE: Compound nucleus reaction.** Nickols, A. (Rockwell Rocketdyne, Canoga Park, CA (United States)). Rockwell International Corp., Canoga Park, CA (United States). Rocketdyne Div. 1 Jan 1972. Sponsored by USDOE, Washington, DC (United States). (NESC–482). Source: RADIATION SHIELDING INFORMATION CENTER.

Description: IBM360; OS/360; FORTRAN IV with one Assembler language subroutine for performing internal I/O. performing intern1 Mag Tape.

COMNUC calculates neutron reaction cross sections using a statistical model for decay of the compound nucleus. Competing reaction types permitted are elastic, discrete and continuum inelastic, gamma ray emission, capture, fission,and n,2n. CASCADE solves the intranuclear gamma ray cascade equation to determine secondary particle emission probabilities. Competing processes considered are gamma ray emission, neutron emission and fission.

7461 (ESTSC–000504C360000) **DYNAMF: Reactor dynamics equations with respect to time.** Patry, J. (RAG-Bericht NR, Wurenlingen (Germany)). OECD Nuclear Energy Agency, 75 - Paris (France). 24 Nov 1965. Sponsored by International Atomic Energy Agency, Vienna (Austria). (NESC–NEA0090). Source: ESTSC.

Description: CDC3600; Normal FORTRAN-monitor.; FORTRAN IV; 1 Mag Tape.

The reactor dynamics equation with respect to time.

7462 (ESTSC–000505I308100) **CEBIS: One dimensional two group diffusion code for reactor calculations.** Ravnik, M. (J. Stefan Institute, Ljubljana (Yugoslavia)); Mele, I. OECD Nuclear Energy Agency, 75 - Paris (France). 1 Feb 1985. Sponsored by National Endowment for the Arts, Washington, DC (United States). (NESC–IAEA0920). Source: ESTSC.

Description: IBM3081; MVS-SP; FORTRAN 77; 1 Mag Tape.

CEBIS is a reactor physics code for calculations of multiplication factor, flux and power distributions in one dimensional cartesian, cylindrical and spherical geometry. It is intended for reactor physics calculations of stationary thermal multipying systems in two group diffusion approximation. Besides the direct solution, the program gives also the adjoint solution of the diffusion equation.

7463 (ESTSC–000506C017000) **CRITIC: One dimensional fuel management code.** Srinivasan, K.R. (Bhabha Atomic Research Centre, Bombay (India)). OECD Nuclear Energy Agency, 75 - Paris (France). 1 May 1984. Sponsored by National Endowment for the Arts, Washington, DC (United States). (NESC–IAEA0873). Source: ESTSC.

Description: CDC CYBER170; NOS; FORTRAN IV; 1 Mag Tape.

CRITIC is a one-dimensional (cylindrical r-geometry) fuel management code. It solves the two-group diffusion theory equations using a finite difference method. Apart from calculating the eigenvalue keff, it has options to determine the extrapolated height or the burnup of a particular region. For the latter option lattice parameters as a function of burnup are needed.

7464 (ESTSC–000549I036000) **TWIGL: 2-d 2-gp space-time diffusion feedback.** Heames, T.J. (Argonne National Lab., IL (United States)). Argonne National Lab., IL (United States). 1 Feb 1968. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (NESC–338). Source: ESTSC.

Description: IBM360; OS/360; FORTRAN IV; 1 Mag Tape.

TWIGL solves the two-dimensional, two-group, space-time neutron diffusion equations in rectangular or cylindrical geometry in the presence of temperature feedback. The neutron diffusion and delayed precursor equations are differenced in both space and time. The thermal-hydraulic description is based on a no-boiling, one-pass model formulated in terms of regionwise-averaged coolant and fuel metal temperatures.

7465 (ESTSC–000550IBMPC00) **MARVEL: Battery/heat engine vehicle analysis.** Marr, W.W. (Argonne National Lab., IL (United States)); Walsh, W.J. Argonne National Lab., IL (United States). 1 Mar 1991. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (NESC–9508). Source: ESTSC.

Description: IBM PC; DOS; PL/I; 1 3.5 Diskette.

MARVEL performs least-life-cycle-cost analyses of battery/heat engine/hybrid vehicle systems to determine the combination of battery and heat engine characteristics for different vehicle types and missions. Simplified models are used for the transmission, motor/generator, controller, and other vehicle components, while a rather comprehensive model is used for the battery. Battery relationships available include the Ragone curve, peak power versus specific energy and depth-of-discharge (DOD), cycle life versus DOD, effects of battery scale, and capacity recuperation due to intermittent driving patterns. Energy management in the operation of the vehicle is based on the specified mission requirements, type and size of the battery, allowable DOD, size of the heat engine, and the management strategy employed. Several optional management strategies are available in MARVEL. The program can be used to analyze a pure electric vehicle, a pure heat engine vehicle, or a hybrid vehicle that employs batteries as well as a heat engine. Cost comparisons for these vehicles can be made on the same basis. Input data for MARVEL are contained in three files generated by the user using three preprocessors which are included. MVDATA processes vehicle specification and mission requirements information, while MBDATA creates a file containing specific peak power as a function of specific energy and DOD, and MPDATA produces the file containing vehicle velocity specification data based on driving cycle information.

7466 (ESTSC/NRC–000075C017000) **GRASS-SST: Fission-gas release & fuel swelling.** Zawadzki, S. (Argonne National Lab., IL (United States)). Argonne National Lab., IL (United States). 1 Jun 1978. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research. (NESC–1094). Source: ESTSC.

Description: CDC CYBER170; NOS 2.4; FORTRAN 77; 1 Mag Tape.

GRASS-SST is a comprehensive, mechanistic model for the prediction of fission-gas behavior in UO2-base fuels during steady-state and transient conditions. GRASS-SST treats fission-gas release and fuel swelling on an equal basis and simultaneously treats all major mechanisms that influence fission-gas behavior. Models are included for intra and inter-granular fission-gas bubble behavior as well as a mechanistic description of the role of grain-edge interlinked porosity on fission-gas release and swelling. GRASS-SST calculations include the effects of gas production from fissioning uranium atoms, bubble nucleation, a realistic equation of state for xenon, lattice bubble diffusivities based on experimental observations, bubble migration, bubble coalescence, re-solution, temperature and temperature gradients, interlinked porosity, and fission-gas interaction with structural defects (dislocations and grain boundaries) on both the distribution of fission-gas within the fuel and on the amount of fission-gas within the fuel and on the amount of fission-gas released from the fuel. GRASS-SST includes the effects of the degree of nonequilibrium in the UO2 lattice on fission-gas bubble mobility and bubble coalescence and also accounts for the observed formation of grain-surface channels. GRASS-SST also includes mechanistic models for grain-growth/grain boundary sweeping and for the behavior of fission gas during liquefaction/dissolution and fuel melting conditions.

7467 (ESTSC/NRC–000075I303300) **GRASS-SST: Fission-gas release & fuel swelling.** Zawadzki, S. (Argonne National Lab., IL (United States)). Argonne National Lab., IL (United States). 1 Jun 1978. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research. (NESC–1094). Source: ESTSC.

Description: IBM3033; MVS; FORTRAN 77; 1 Mag Tape.

GRASS-SST is a comprehensive, mechanistic model for the prediction of fission-gas behavior in UO2-base fuels during steady-state and transient conditions. GRASS-SST treats fission-gas release and fuel swelling on an equal basis and simultaneously treats all major mechanisms that influence fission-gas behavior. Models are included for intra and inter-granular fission-gas bubble behavior as well as a mechanistic description of the role of grain-edge interlinked porosity on fission-gas release and swelling. GRASS-SST calculations include the effects of gas production from fissioning uranium atoms, bubble nucleation, a realistic equation of state for xenon, lattice bubble diffusivities based on experimental observations, bubble migration, bubble coalescence, re-solution, temperature and temperature gradients, interlinked porosity, and fission-gas interaction with structural defects (dislocations and grain boundaries) on both the distribution of fission-gas within the fuel and on the amount of fission-gas within the fuel and on the amount of fission-gas released from the fuel. GRASS-SST includes the effects of the degree of nonequilibrium in the UO2 lattice on fission-gas bubble mobility and bubble coalescence and also accounts for the observed formation of grain-surface channels. GRASS-SST also includes mechanistic models for grain-growth/grain boundary sweeping and for the behavior of fission gas during liquefaction/dissolution and fuel melting conditions.

7468 (ESTSC/NRC–000075IBMPC00) **GRASS-SST: Fission-gas release & fuel swelling.** Zawadzki, S. (Argonne National Lab., IL (United States)). Argonne National Lab., IL (United States). 1 Jun 1978. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research. (NESC–1094). Source: ESTSC.

Description: IBM PC; DOS 3.3; DOS 4.0; FORTRAN 77; 1 5.25 Diskette.

GRASS-SST is a comprehensive, mechanistic model for the prediction of fission-gas behavior in UO2-base fuels during steady-state and transient conditions. GRASS-SST treats fission-gas release and fuel swelling on an equal basis and simultaneously treats all major mechanisms that influence fission-gas behavior. Models are included for intra and inter-granular fission-gas bubble behavior as well as a mechanistic description of the role of grain-edge interlinked porosity on fission-gas release and swelling. GRASS-SST calculations include the effects of gas production from fissioning uranium atoms, bubble nucleation, a realistic equation of state for xenon, lattice bubble diffusivities based on experimental observations, bubble migration, bubble coalescence, re-solution,

temperature and temperature gradients, interlinked porosity, and fission-gas interaction with structural defects (dislocations and grain boundaries) on both the distribution of fission-gas within the fuel and on the amount of fission-gas within the fuel and on the amount of fission-gas released from the fuel. GRASS-SST includes the effects of the degree of nonequilibrium in the UO2 lattice on fission-gas bubble mobility and bubble coalescence and also accounts for the observed formation of grain-surface channels. GRASS-SST also includes mechanistic models for grain-growth/grain boundary sweeping and for the behavior of fission gas during liquefaction/dissolution and fuel melting conditions.

7469 (ESTSC/NRC/R–000126C760000) **TRAC-PF1/MOD1: Best-estimate analysis PWR LOCA.** Mahaffy, J.H. (Los Alamos National Lab., NM (United States)). Los Alamos National Lab., NM (United States). 1 Jul 1986. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research. (NESC–836). Source: ESTSC.

Description: CDC7600; SCOPE 2.1.5; FORTRAN IV (FTN 4.5 FORTRAN compiler); 1 Mag Tape. The code is modified through CDC Update files.

TRAC-PF1/MOD1 performs best-estimate predictions of loss-of-coolant accidents (LOCAS) and other transients in pressurized light water reactors (LWRs). The code also models a wide range of thermal hydraulic experiments in reduced scale facilities. Models used include reflood, multi-dimensional two-phase flow, nonequilibrium thermodynamics, generalized heat transfer, and reactor kinetics. Automatic steady-state and dump/restart capabilities also are provided.

7470 (ESTSC/NRC/R–000126CY00100) **TRAC-PF1/MOD1: Best-estimate analysis PWR LOCA.** Mahaffy, J.H. (Los Alamos National Lab., NM (United States)). Los Alamos National Lab., NM (United States). 1 Jul 1986. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research. (NESC–836). Source: ESTSC.

Description: CRAY1; CTSS; FORTRAN IV; 1 Mag Tape. The code is modified through CDC Update files.

TRAC-PF1/MOD1 performs best-estimate analyses of loss-of-coolant accidents (LOCAS) and other transients in pressurized light water reactors (LWRs). The code also models a wide range of thermal-hydraulic experiments in reduced-scale facilities. Models used include reflood, multi-dimensional two-phase flow, nonequilibrium thermodynamics, generalized heat transfer, and reactor kinetics. Automatic steady-state and dump/restart capabilities also are provided.

7471 (ESTSC/NRC/R–000143CYYMP00) **MINET: Thermal-hydraulic systems analysis.** Van Tuyle, G.J. (Brookhaven National Lab., Upton, NY (United States)). Brookhaven National Lab., Upton, NY (United States). 1 Dec 1989. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research. (NESC–1114). Source: ESTSC.

Description: CRAY Y-MP; UNICOS 4.0; FORTRAN 66; 1 Mag Tape. The Cray version of MINET does not execute using the CFT77 compiler; the CFT compiler is required.

MINET (Momentum Integral NETwork) was developed for the transient analysis of intricate fluid flow and heat transfer networks, such as those found in the balance of plant in power generating facilities. It can be utilized as a stand-alone program or interfaced to another computer program for concurrent analysis. Through such coupling, a computer code limited by either the lack of required component models or large computational needs can be extended to more fully represent the thermal hydraulic system thereby reducing the need for estimating essential transient boundary conditions. The MINET representation of a system is one or more networks of volumes, segments, and boundaries linked together via heat exchangers only, i.e., heat can transfer between networks, but fluids cannot. Volumes are used to represent tanks or other volume components, as well as locations in the system where significant flow divisions or combinations occur. Segments are composed of one or more pipes, pumps, heat exchangers, turbines, and/or valves each represented by one or more nodes. Boundaries are simply points where the network interfaces with the user or another computer code. Several fluids can be simulated, including water, sodium, NaK, and air.

7472 (ESTSC/NRC/R–000143I309000) **MINET: Thermal-hydraulic systems analysis.** Van Tuyle, G.J. (Brookhaven National Lab., Upton, NY (United States)). Brookhaven National Lab., Upton, NY (United States). 1 Dec 1989. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research. (NESC–1114). Source: ESTSC.

Description: IBM3090; VM/CMS; FORTRAN 77 (99%) and BAL (1%); 1 Mag Tape. The IBM version of MINET includes Basic Assembler Language subroutines ICLOCK, IDAY, and TIME to return elapsed CPU time, current date, and time, respectively.

MINET (Momentum Integral NETwork) was developed for the transient analysis of intricate fluid flow and heat transfer networks, such as those found in the balance of plant in power generating facilities. It can be utilized as a stand-alone program or interfaced to another computer program for concurrent analysis. Through such coupling, a computer code limited by either the lack of required component models or large computational needs can be extended to more fully represent the thermal hydraulic system thereby reducing the need for estimating essential transient boundary conditions. The MINET representation of a system is one or more networks of volumes, segments, and boundaries linked together via heat exchangers only, i.e., heat can transfer between networks, but fluids cannot. Volumes are used to represent tanks or other volume components, as well as locations in the system where significant flow divisions or combinations occur. Segments are composed of one or more pipes, pumps, heat exchangers, turbines, and/or valves each represented by one or more nodes. Boundaries are simply points where the network interfaces with the user or another computer code. Several fluids can be simulated, including water, sodium, NaK, and air.

7473 (ESTSC/NRC/R–000146I303300) **ORSMAC: Fluid circulation patterns near jets.** Park, J.E. (Oak Ridge Gaseous Diffusion Plant, TN (United States)). Oak Ridge K-25 Site, TN (United States). 1 Dec 1983. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research. (NESC–1112). Source: ESTSC.

Description: IBM3033; MVS (IBM3033); VM/CMS (IBM4331);FORTRAN (91%) and BAL (9%); 1 Mag Tape. The IBM assembly language routines include IDAY which provides the date in MM-DD-YY format, TIME which provides the time of day as eight characters (hour, minutes, and seconds separated by periods), ICLOCK which returns the reading of the computer time with the value in hundredths of seconds to be stored in an integer variable, and JSTIME which returns the job step time remaining.

ORSMAC predicts the temperatures occurring in the immediate vicinity (the near field) of a hot water discharge from a power plant. ORSMAC numerically solves the differential equations governing the conservation of mass, momentum, and energy in a two-dimensional vertical plane containing the power plant discharge. The model allows arbitrary discharge angle and can accommodate either quiescent or cross-flowing ambient conditions.

7474 (ESTSC/NRC/R–000147I303300) **ESTONE: Power plant impact model river flows.** Eraslan, A.H. (Oak Ridge National Lab., Oak Ridge, TN (United States)). Oak Ridge National Lab., TN (United States). 1 Nov 1983. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research. (NESC–1109). Source: ESTSC.

Description: IBM3033; MVS (IBM3033); VM/CMS (IBM4331);FORTRAN IV; 1 Mag Tape.

ESTONE is a discrete-element mathematical transport model for predicting fast-transient (tidal-transient), one-dimensional hydrodynamic, thermal, and salinity (or any other dissolved, nonreacting constituent concentration) conditions in controlled rivers and tidal estuaries. The mathematical model incorporates both the lateral and the vertical variations of the velocity, temperature, and salinity conditions over the cross-section areas in formulating the forces and the transport rates along the curvilinear longitudinal axis of the main flow channel. The model is specifically designed for long-term applications to site-specific problems that require accurate predictions of the hydrodynamic, thermal, and salinity conditions for the

assessment of the aggregated environmental impact of multiple power plant operations on the common water body. ESTONE can also be utilized for predicting the water stage and flow conditions under severe climatological conditions, including storm surge and regional flooding events. Furthermore, it can predict the fast-transient variations of flow and water quality conditions after sudden and drastic changes in the operational characteristics of controlled-flow dams and power plants that could occur under conditions associated with real or hypothetical major accident scenarios. ESTONE can be readily implemented as a reliable and cost-effective methodology for the assessment of the environmental impact in the preparation of the environmental statements for the licensing of power plants on controlled rivers and tidal estuaries.

7475 (ESTSC/NRC/R–000148I036000) **ORINC: 1-d implicit heat conduction solution.** Ott, L. (Oak Ridge National Lab., Oak Ridge, TN (United States)). Oak Ridge National Lab., TN (United States). 1 Nov 1977. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Regulatory Research. (NESC–1116). Source: ESTSC.

Description: IBM360; Operating system independent; FORTRAN IV; 1 Mag Tape.

ORINC is an inverse computer program which solves a one-dimensional, transient, lumped-parameter, implicit formulation of the conduction equation to determine both the transient surface temperature and the transient surface heat flux of electrically heated rods during a simulated loss-of-coolant accident. The program was developed specifically for analysis of the Thermal-Hydraulic Test Facility Blowdown Heat Transfer (THTF-BDHT) test data as part of the overall light-water-reactor (LWR) safety research program.

7476 (ESTSC/NRC/R–000150I303X00) **SPIRT-NRC: Containment spray iodine removal.** Postma, A.K. (Benton City Technology, Washington, DC (United States)); Sherry, R.R.; Tam, P.S. Oak Ridge National Lab., TN (United States). 1 Oct 1978. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Office of Nuclear Reactor Regulation. (NESC–1100). Source: ESTSC.

Description: IBM303X; MVS (IBM3033); VM/CMS (IBM4331);FORTRAN IV; 1 Mag Tape.

SPIRT predicts the washout of airborne contaminants in containment vessels under postulated loss-of-coolant accident (LOCA) conditions. SPIRT calculates iodine removal constants (lambdas) for post-LOCA containment spray systems. It evaluates the effect of the spectrum of drop sizes emitted by the spray nozzles,the effect of drop coalescence, and the precise solution of the time-dependent diffusion equation. STEAM-67 routines are included for calculating the properties of steam and water according to the 1967 ASME Steam Tables.

7477 (ETDE-IT–92-104) **Solution of variable coefficients PDEs by means of BEM and perturbation technique.** Rangogni, R. Ente Nazionale per l'Energia Elettrica, Milan (Italy). Centro di Ricerca Idraulica e Strutturale. 1991. 10p. (CONF-9108179–2: 13. Boundary element methods (BEM) conference, Tulsa, OK (United States), 21-23 Aug 1991). Order Number DE93748437. Source: OSTI; NTIS (US Sales Only).

Numerical solution of variable coefficients PDEs (Partial Differential Equations) by the BEM (Boundary Element Method) is quite difficult as the Green function is unknown and not general. In this paper, a procedure is presented that enables the solution of some types of non-constant coefficients PDEs by using the standard Green function used for the Laplace equation. This is achieved by coupling the BEM and perturbation technique. After stating the procedure, the steady state incomprensible lubricaiton problem for sliding bearings is numerically solved to show the efficiency and accuracy of the proposed technique.

7478 (IEN–27/91) **QUASAR - an interactive program for spectrum analysis in personal computers.** Auler, L.T.; Nobrega, J.A.W. da. Instituto de Engenharia Nuclear (IEN), Rio de Janeiro, RJ (Brazil). Nov 1991. [31] (In Portuguese). Order Number DE93609814. Source: OSTI; NTIS (US Sales Only); INIS.

The QUASAR software for the interactive analysis and report of energy (pulse-height) and time (multichannel scaling) spectra is described. The operating instructions as well as the mathematical methods and algorithms used by the program are presented in detail. This program is an extension to the PULSAR program. (author).

7479 (JAERI–1327) **Development of BERMUDA: a radiation transport code system, 1: Neutron transport codes.** Suzuki, Tomoo (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Hasegawa, Akira; Tanaka, Shun-ichi; Nakashima, Hiroshi. Japan Atomic Energy Research Inst., Tokyo (Japan). May 1992. 119p. Order Number DE93753274. Source: OSTI; NTIS; INIS.

A radiation transport code system BERMUDA has been developed for one-, two- and three-dimensional geometries. The time-independent transport equation is numerically solved using a direct integration method in a multigroup model, to obtain spatial, angular and energy distributions of neutron, gamma rays or adjoint neutron flux. As to group constants, a library with an any structure of energy groups is capable to be produced from a data base JSSTDL, or by a processing code PROF-GROUCH-G/B, selecting objective nuclear data through a retrieval system EDFSRS. Validity of the present code system has been tested by analyzing the shielding benchmark experiments. The test has shown that accurate results are obtainable with this system especially in deep penetration calculation. Described are the devised calculation method and the results of validity tests. Input data specification, job control languages and output data are also described as a user's manual for the following four neutron transport codes: BERMUDA-1DN : sphere, slab(S_{20}), BERMUDA-2DN : cylinder (S_8), BERMUDA-2DN-S16 : cylinder (S_{16}), and BERMUDA-3DN : rectangular parallelpiped (S_8). (J.P.N.).

7480 (JAERI-M–92-084) **Study on the concurrent calculation with a multitransputer network: Relation between processing time and overhead.** Inomata, Shinji (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Suzuki, Katsuo. Japan Atomic Energy Research Inst., Tokyo (Japan). Jun 1992. 86p. (In Japanese). Order Number DE93753191. Source: OSTI; NTIS; INIS.

A relation between the calculation processing time and the overhead of multitransputer network is studied in performing several concurrent calculations. Hardware configuration we used was a ring-type linked nine transputer network on an INMOS B008 mother board which was inserted into a slot of a personal computer compatible with IBM PC/AT. Further we used the occam2 toolset of MS-DOS version to write the calculation programs in the occam2 language. On arithmetic operations, some trigonometric and transcendental functions and numerical integrations, the calculation time and overhead were measured. The results show that the relative calculation speed is proportional to the number of transputers when the ratio of calculation time to overhead is much greater than 1.0. And the overhead is consumed in inter-communicating among transputers for the parallel calculation set-up. (author).

7481 (JAERI-M–92-089) **Users' manual for fault tree analysis code: CUT-TD.** Watanabe, Norio (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Kiyota, Mikio. Japan Atomic Energy Research Inst., Tokyo (Japan). Jun 1992. 57p. (In Japanese). Order Number DE93753272. Source: OSTI; NTIS; INIS.

The CUT-TD code has been developed to find minimal cut sets for a given fault tree and to calculate the occurrence probability of its top event. This code uses an improved top-down algorithm which can enhance the efficiency in deriving minimal cut sets. The features in processing techniques incorporated into CUT-TD are as follows: (1) Consecutive OR gates or consecutive AND gates can be coalesced into a single gate. As a result, this processing directly produces cut sets for the redefined single gate with each gate not being developed. (2) The independent subtrees are automatically identified and their respective cut sets are separately found to enhance the efficiency in processing. (3) The minimal cut sets can be obtained for the top event of a fault tree by combining their respective minimal cut sets for several gates of the fault tree. (4) The user can reduce the computing time for finding minimal cut sets and control the size and significance of cut sets by inputting a minimum probability cut off and/or a maximum order cut off. (5) The user can select events that need not to be further developed

in the process of obtaining minimal cut sets. This option can reduce the number of minimal cut sets, save the computing time and assists the user in reviewing the result. (6) Computing time is monitored by the CUT-TD code so that it can prevent the running job from abnormally ending due to excessive CPU time and produce an intermediate result. The CUT-TD code has the ability to restart the calculation with use of the intermediate result. This report provides a users' manual for the CUT-TD code. (author).

7482 (JAERI-M–92-105) **Installation of a new Fortran compiler and effective programming method on the vector supercomputer.** Nemoto, Toshiyuki (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Suzuki, Koichiro; Watanabe, Kenji; Machida, Masahiko; Osanai, Seiji; Isobe, Nobuo; Harada, Hiroo; Yokokawa, Mitsuo. Japan Atomic Energy Research Inst., Tokyo (Japan). Jul 1992. 217p. (In Japanese). Order Number DE93753322. Source: OSTI; NTIS; INIS.

The Fortran compiler, version 10 has been replaced with the new one, version 12 (V12) on the Fujitsu Computer system at JAERI since May, 1992. The benchmark test for the performance of the V12 compiler is carried out with 16 representative nuclear codes in advance of the installation of the compiler. The performance of the compiler is achieved by the factor of 1.13 in average. The effect of the enhanced functions of the compiler and the compatibility to the nuclear codes are also examined. The assistant tool for vectorization TOP10EX is developed. In this report, the results of the evaluation of the V12 compiler and the usage of the tools for vectorization are presented. (author).

7483 (JAERI-M–92-115) **The MIG2DF computer code user's manual.** Kimura, Hideo (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment). Japan Atomic Energy Research Inst., Tokyo (Japan). Aug 1992. 53p. Order Number DE93754297. Source: OSTI; NTIS; INIS.

This report describes the MIG2DF computer code and presents the direction to use the code effectively. MIG2DF is a two-dimensional, finite element code simulating saturated-unsaturated groundwater flow and radionuclide transport in porous media for the safety evaluation of radioactive waste disposal. Simulations can be performed in a vertical or horizontal cross-section, or an axisymmetric configuration. Heterogeneities and anisotropy of geologic media are handled by taking advantage of the finite element approach. The equation of groundwater flow is based on the Darcy's law and discretized by the Galerkin finite element method. For the simulations of radionuclide transport, MIG2DF takes account of advection, hydrodynamic dispersion, equilibrium sorption and decay chains. The equations of radionuclide transport are discretized by the Bubnov-Galerkin finite element method. (author).

7484 (JINR-R–9-91-37) **Distributed computation complex for simulation of charged particle accelerators.** Vorozhtsov, S.B.; Gromov, V.O.; Karlov, A.A.; Lomov, A.K.; Saenko, V.A. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Nuclear Problems. 1991. [10] (In Russian). Order Number DE93609816. Source: OSTI; NTIS (US Sales Only); INIS.

A distributed soft- and hardware complex based on the AT-286, 386 type PC and local networks JINET in JINR is considered. The complex is designed for computer simulation of charged particle accelerators. The operating part of the complex was used in designing a high-intensity injector cyclotron of energy 7.5 MeV/nucleon for the installation DC-1, which allowed the computation to be performed in shorter time and with higher efficiency. 16 refs.; 1 fig.

7485 (JINR-R–10-90-589) **Digital CAMAC modules: Issue 18.** Antyukhov, V.A.; Zhuraviev, N.I.; Ignat'ev, S.V.; Krajpe, G.; Malyshev, A.V.; Opalek, T.; Sidorov, V.T.; Sinaev, A.N.; Stakhin, A.A.; Churin, I.N. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Nuclear Problems. 1990. [26] (In Russian). Order Number DE93609532. Source: OSTI; NTIS (US Sales Only); INIS.

Data sheet and block diagrams of 7 CAMAC new modules are presented. They consist of a charge analyzer, a colour TV-monitor interface with an additional memory unit, the IEC625 interface, a serial crate controller, a crate controller for the IBM PC/XT/AT computer and a personal computer bus emulator. 17 refs.; 7 figs.; 1 tab.

7486 (JINR-R–10-91-105) **Software conception and structure of automated workstation for an experimental data processing.** Ivanov, V.G.; Nodarse, F.F.; Ehrdehnehdehlgehr, T. Joint Inst. for Nuclear Research, Dubna (Russian Federation). Lab. of Computing Techniques and Automation. 1991. [11] (In Russian). Order Number DE93609815. Source: OSTI; NTIS (US Sales Only); INIS.

In order to increase user efficiency and possibilities in the use of experimental data processing distributive system based on personal computers, the automated experimental data processing workstation are created. Basic principles including different kinds of users and their access attributes, operating regimes, the roll of the intelligent computer assistant, and software and hardware needed are analysed. Software includes knowledge base, data base, AI system building tools, intelligent system applications, general programs and other service and teaching programs. 7 refs.; 4 figs.

7487 (LA-UR–92-3339) **Review of quantum computation.** Lloyd, S. Los Alamos National Lab., NM (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9208189–1: International symposium on quantum physics in the universe, Tokyo (Japan), 19-23 Aug 1992). Order Number DE93003735. Source: OSTI; NTIS; INIS; GPO Dep.

Digital computers are machines that can be programmed to perform logical and arithmetical operations. Contemporary digital computers are "universal," in the sense that a program that runs on one computer can, if properly compiled, run on any other computer that has access to enough memory space and time. Any one universal computer can simulate the operation of any other; and the set of tasks that any such machine can perform is common to all universal machines. Since Bennett's discovery that computation can be carried out in a non-dissipative fashion, a number of Hamiltonian quantum-mechanical systems have been proposed whose time-evolutions over discrete intervals are equivalent to those of specific universal computers. The first quantum-mechanical treatment of computers was given by Benioff, who exhibited a Hamiltonian system with a basis whose members corresponded to the logical states of a Turing machine. In order to make the Hamiltonian local, in the sense that its structure depended only on the part of the computation being performed at that time, Benioff found it necessary to make the Hamiltonian time-dependent. Feynman discovered a way to make the computational Hamiltonian both local and time-independent by incorporating the direction of computation in the initial condition. In Feynman's quantum computer, the program is a carefully prepared wave packet that propagates through different computational states. Deutsch presented a quantum computer that exploits the possibility of existing in a superposition of computational states to perform tasks that a classical computer cannot, such as generating purely random numbers, and carrying out superpositions of computations as a method of parallel processing. In this paper, we show that such computers, by virtue of their common function, possess a common form for their quantum dynamics.

7488 (LA-UR–92-3363) **Extension of high-resolution schemes for systems to multiple dimensions.** Rider, W.J. Los Alamos National Lab., NM (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9206313–1: AIAA computational fluid dynamics conference, Orlando, FL (United States), 21-23 Jun 1992). Order Number DE93003734. Source: OSTI; NTIS; GPO Dep.

The extension of high-resolution schemes from one to two or more dimensions can be accomplished in a number of ways. In this paper, several methods for extending one-dimensional Godunov-type schemes to two-dimensional problems are discussed. The different algorithms are described, and results are given for several standard test problems. these tests reveal that standard dimensional splitting has a number of advantages in terms of performance and efficiency.

7489 (LA-UR–92-3387) **Flexible prior models in Bayesian image analysis.** Hanson, K.M. Los Alamos National Lab., NM (United States). [1992]. 9p. Sponsored by USDOE, Washington, DC

(United States). DOE Contract W-7405-ENG-36. (CONF-9207167–1: Entropy and Bayesian workshop, Paris (France), Jul 1992). Order Number DE93003728. Source: OSTI; NTIS; GPO Dep.

A new class of prior models is proposed for Bayesian image analysis. This class of priors provides an inherent geometrical flexibility, which is achieved through a transformation of the coordinate system of the prior distribution or model into that of the object under analysis. Thus prior morphological information about the object being reconstructed may be adapted to various degrees to match the available measurements. An example of tomographic reconstruction illustrates the potential of this approach.

7490 (LA-UR–92-3495) **Research in models for massively parallel computing.** Morse, N.R. Los Alamos National Lab., NM (United States). 21 Oct 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9210229–1: IEEE scientific supercomputing subcommittee meeting, Livermore, CA (United States), 25 Oct 1992). Order Number DE93003748. Source: OSTI; NTIS; GPO Dep.

Workstation-Based Supercomputing: Supercomputing in the DoE has been traditionally performed on von Neumann vector pipeline machines. In the past few years, a belief has developed that advances in supercomputing capability in the future must come from massively parallel architectures. When considering such architectures, many questions remain which are active areas of research. Examples of research subjects for massively parallel computing paradigms are communication structures, memory structures, node processor architectures, latency hiding, algorithm development, switching schemes, communication bandwidth and support software. Gigabit Networks: A problem which has existed in computing since networks were invented is that the quality of service received by those using a computing resource is inversely proportional to the user's physical distance from the server. The goal of the CASA Gigabit project is to remove this restriction by inventing gigabit speed networks with support protocols, switches, etc. which will operate at global distances.

7491 (LA-UR–92-3499) **SNFS allows for dynamic file space allocation.** Pfaff, R.T.; Siciliano, C.L.B. Los Alamos National Lab., NM (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9209204–4: Cray users group meeting, Washington, DC (United States), 14-18 Sep 1992). Order Number DE93003784. Source: OSTI; NTIS; GPO Dep.

Simulated network file server (SNFS) replaces or supplements data migration. Stubs allow executables to appear to be where users expect them; actual executables reside in sub-directories in the scratch area (/usr/tmp). SNFS transparently checks for a file in /usr/tmp. If it exists, SNFS executes it, otherwise, SNFS retrieves it from archival storage (CFS), installs it in /usr/tmp, and then executes it. Space allocated for utilities can be significantly reduced. Since /usr/tmp files are periodically purged, only frequently used software remains on disk and such space is dynamically managed. SNFS also eases installation of software on multiple machines SNFS runs with Secure Mode UNICOS and Multi-Level Security (MLS).

7492 (LA-UR–92-3568) **Efficiently modeling neural networks on massively parallel computers.** Farber, R.M. Los Alamos National Lab., NM (United States). [1992]. 11p. Sponsored by USDOE, Washington, DC (United States); Department of Health and Human Services, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9206318–1: NASA conference, Houston, TX (United States), 1-3 Jun 1992). Order Number DE93003787. Source: OSTI; NTIS; GPO Dep.

Neural networks are a very useful tool for analyzing and modeling complex real world systems. Applying neural network simulations to real world problems generally involves large amounts of data and massive amounts of computation. To efficiently handle the computational requirements of large problems, we have implemented at Los Alamos a highly efficient neural network compiler for serial computers, vector computers, vector parallel computers, and fine grain SIMD computers such as the CM-2 connection machine. This paper will describe the mapping used by the compiler to implement feed-forward backpropagation neural networks for a SIMD architecture parallel computer. Thinking Machines Corporation has benchmarked our code at 1.3 billion interconnects per second (approximately 3 gigaflops) on a 64,000 processor CM-2 connection machine (Singer 1990). This mapping is applicable to other SMM computers and can be implemented on computers such as the CM-5 connection machine. Our mapping has virtually no communications overhead with the exception of the communications required for a global summation across the processors. We can efficiently model very large neural networks which have many neurons and interconnects and our mapping can be extend to arbitrarily large networks by merging the memory space of separate processors with fast adjacent processor inter-processor communications. This paper will consider the simulation of only feed forward neural network although this method is extendible to recurrent networks.

7493 (LA-UR–92-3600) **Los Alamos HPDS: High-speed data transfer.** Collins, M.W.; Brewton, J.; Cook, D.; Jones, L.; Kelly, K.; Kluegel, D.L.; Krantz, D.; Ramsey, C. Los Alamos National Lab., NM (United States). [1992]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9204217–1: 12. Institute of Electrical and Electronic Engineers (IEEE) symposium on mass storage systems, Monterey, CA (United States), 25-29 Apr 1992). Order Number DE93003804. Source: OSTI; NTIS; GPO Dep.

The Los Alamos High-Performance Data System (HPDS) is being developed to meet data storage and data access requirements of Grand Challenge and National Security problems running in a high-performance computing environment. HPDS is a new-generation data storage system in which storage devices are directly connected to a network, data is transferred directly between client machines and storage devices, and software distributed on workstations provides system management and control capabilities. Essential to the success of HPDS will be the ability to effectively use HIPPI networks and HIPPI-attached storage devices for high-speed data transfer. This paper focuses on the peer-to-peer data transfer protocol that has been developed for HPDS, and it describes the HPDS implementation approach. Because HPDS is under development, many changes will have taken place between the time this paper was written in October 1992 and its presentation in April 1993.

7494 (LA-UR–92-3725) **Inverting sets and the packing problem.** Faber, V. (Los Alamos National Lab., NM (United States)); Goldberg, M.K.; Knill, E.; Spencer, T.H. Los Alamos National Lab., NM (United States). [1992]. 16p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract W-7405-ENG-36. Grant MDA-904-90-H-4027;Grant IRI-8900511;Grant CDA-8805910;Gran (CONF-9206317–1: 7. international conference on graph theory, combinatorics, algorithms, and applications, Kalamazoo, MI (United States), 1-5 Jun 1992). Order Number DE93003822. Source: OSTI; NTIS; GPO Dep.

Given a set V, a subset S, and a permutation π of V, we say that π permutes S if $\pi(S) \cap S = \theta$. Given a collection $S = (V; S_1,..., S_m)$, where $S_i \subseteq V$ $(i = 1,...,m)$, we say that S is invertible if there is a permutation π of V such that $\pi(S_i) \subseteq V - S_i$. In this paper, we present necessary and sufficient conditions for the invertibility of a collection and construct a polynomial algorithm which determines whether a given collection is invertible. For an arbitrary collection, we give a lower bound for the maximum number of sets that can be inverted. Finally, we consider the problem of constructing a collection of sets such that no sub-collection of size three is invertible. Our constructions of such collections come from solutions to the packing problem with unbounded block sizes. We prove several new lower and upper bounds for the packing problem and present a new explicit construction of packing.

7495 (NREL/TP–411-5165) **Principles and applications of measurement and uncertainty analysis in research and calibration.** Wells, C.V. National Renewable Energy Lab., Golden, CO (United States). Nov 1992. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. (CONF-9209271–1: 3. annual infrared radiometric sensor calibration symposium, Logan, UT (United States), 14-17 Sep 1992). Order Number DE93000034. Source: OSTI; NTIS; GPO Dep.

Interest in Measurement Uncertainty Analysis has grown in the past several years as it has spread to new fields of application,

and research and development of uncertainty methodologies have continued. This paper discusses the subject from the perspectives of both research and calibration environments. It presents a history of the development and an overview of the principles of uncertainty analysis embodied in the United States National Standard, ANSI/ ASME PTC 19.1-1985, Measurement Uncertainty. Examples are presented in which uncertainty analysis was utilized or is needed to gain further knowledge of a particular measurement process and to characterize final results. Measurement uncertainty analysis provides a quantitative estimate of the interval about a measured value or an experiment result within which the true value of that quantity is expected to lie. Years ago, Harry Ku of the United States National Bureau of Standards stated that "The informational content of the statement of uncertainty determines, to a large extent, the worth of the calibrated value." Today, that statement is just as true about calibration or research results as it was in 1968. Why is that true? What kind of information should we include in a statement of uncertainty accompanying a calibrated value? How and where do we get the information to include in an uncertainty statement? How should we interpret and use measurement uncertainty information? This discussion will provide answers to these and other questions about uncertainty in research and in calibration. The methodology to be described has been developed by national and international groups over the past nearly thirty years, and individuals were publishing information even earlier. Yet the work is largely unknown in many science and engineering arenas. I will illustrate various aspects of uncertainty analysis with some examples drawn from the radiometry measurement and calibration discipline from research activities.

7496 (ORNL/TM–12172) **The LILARTI neural network system.** Allen, J.D. Jr.; Schell, F.M.; Dodd, C.V. Oak Ridge National Lab., TN (United States). Oct 1992. 145p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC05-84OR21400. Grant MIPR FY1457-91-N5004. Order Number DE93004276. Source: OSTI; NTIS; GPO Dep.

The material of this Technical Memorandum is intended to provide the reader with conceptual and technical background information on the LILARTI neural network system of detail sufficient to confer an understanding of the LILARTI method as it is presently allied and to facilitate application of the method to problems beyond the scope of this document. Of particular importance in this regard are the descriptive sections and the Appendices which include operating instructions, partial listings of program output and data files, and network construction information.

7497 (ORNL/TM–12204) **Predicting structure in nonsymmetric sparse matrix factorizations.** Gilbert, J.R. (Xerox Palo Alto Research Center, CA (United States)); Ng, E.G. Oak Ridge National Lab., TN (United States). Oct 1992. 43p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE93003365. Source: OSTI; NTIS; GPO Dep.

Many computations on sparse matrices have a phase that predicts the nonzero structure of the output, followed by a phase that actually performs the numerical computation. We study structure prediction for computations that involve nonsymmetric row and column permutations and nonsymmetric or non-square matrices. Our tools are bipartite graphs, matchings, and alternating paths. Our main new result concerns LU factorization with partial pivoting. We show that if a square matrix A has the strong Hall property (i.e., is fully indecomposable) then an upper bound due to George and Ng on the nonzero structure of L + U is as tight as possible. To show this, we prove a crucial result about alternating paths in strong Hall graphs. The alternating-paths theorem seems to be of independent interest: it can also be used to prove related results about structure prediction for QR factorization that are due to Coleman, Edenbrandt, Gilbert, Hare, Johnson, Olesky, Pothen, and van den Driessche.

7498 (PNL-SA–20706) **The effects of using a hypertext tool for selecting design guidelines.** Fox, J.A. Pacific Northwest Lab., Richland, WA (United States). Oct 1992. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-921048–6: Human Factors Society (HFS) annual meeting, Atlanta, GA (United States), 12-16 Oct 1992). Order Number DE93004402. Source: OSTI; NTIS; GPO Dep.

Designing a User-system Interface (USI) is a complex task that has been approached in many ways. One approach has been to use USI design guidelines to help improve the quality and consistency of USIs. To be effective, a general set of guidelines must be tailored to a specific application. One popular set of guidelines is the Smith and Mosier Guidelines for Designing User Interface Software (1986). This study investigated the effects of using a computer-based hypertext design aid (DRUID, Dynamic Rules for User Interface Design) for the selection of USI guidelines by both experienced and novice Guidelines users. Results indicate that, in general, DRUID performed as well as the book. Subjects used both the book and hypertext presentation media effectively. However subjects selected more guidelines that were relevant with the book because subjects read less when using DRUID. Subjectively, the software was preferred because it provided assistance in the selection process and provided additional time-saving design aids not available in the book. Results showed that the presentation of the guidelines could be improved for both media, and many of the factors that led subjects to select fewer relevant guidelines with DRUID could be overcome with improved USI design and implementation of DRUID. This suggests that, to overcome the limitations of presenting large texts on-line, "value added" (e.g., automated checklists) features should be incorporated into on-line tools to help users better perform their tasks.

7499 (SAND–92-1295) **Delivery of very high bandwidth with ATM switches and SONET.** Gossage, S.A. Sandia National Labs., Albuquerque, NM (United States). Oct 1992. 37p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE93004274. Source: OSTI; NTIS; GPO Dep.

The choice of technologies for the delivery of very high bandwidth throughout a facility capable of ultimately achieving gigabits per second performance, is a crucial one for any high technology facility. The components of a high bandwidth delivery system include high performance sources and sinks in the form of central facilities (major mainframes, large file storage and specialized peripherals) and powerful, full bandwidth distributed local area networks (LANs). In order to deliver bandwidth among the sources and sinks, a ubiquitous inter-/intra-building cable plant consisting of single mode and multimode fiber as well as twisted pair copper is required. The selection of the "glue" to transport and interconnect the LANs with the central facility over the pervasive cable plant is the focus of this paper. A design philosophy for high performance communications systems is proposed. A description of the traditional problems that must be overcome to provide very high bandwidth beyond the narrow confines of a computer center is given. The advantages of ATM switching and SONET physical transport are explored in the structured design presentation. The applicability of Asynchronous Transfer Mode (ATM) switching (interconnection) and Synchronous Optical NETwork (SONET) (transport) for high bandwidth delivery is described using the environment and requirements of Sandia National Laboratories as a context to examine the suitability of those technologies. The synergy and utility of ATM and SONET in the campus network are explored. Other methods for distributing high data rates are compared and contrasted to ATM and SONET with respect to cable plant impact, reliability/availability, maintainability, and capacity. Sandia is implementing a standards based foundation utilizing a pervasive single mode fiber cable plant, SONET transport, and ATM switching to meet the goals of gigabit networking.

7500 (SLAC-PUB–5913) **Network management, status and directions.** Cottrell, R.L.A.; Streater, T.C. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Sep 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-920966–7: 10. conference on computing in high energy physics, Annecy (France), 21-25 Sep 1992). Order Number DE93004003. Source: OSTI; NTIS; INIS; GPO Dep.

It has been said that the "network is the system". This implies providing levels of service, reliability, predictability and availability that are commensurate with or better than those that individual

computers provide today. To provide this requires integrated network management for interconnected networks of heterogeneous devices covering both the local campus and across the world and spanning many administrative domains. This talk will review the status of existing tools to address management for networks. It draws on experience from both within and outside the HEP community.

7501 (SLAC-PUB–5921) **Hippoplotamus.** Gravina, M.F.; Kunz, P.F.; Pavel, T.J.; Rensing, P.E. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Sep 1992. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-920966–8: 10. conference on computing in high energy physics, Annecy (France), 21-25 Sep 1992). Order Number DE93004004. Source: OSTI; NTIS; INIS; GPO Dep.

Hippoplotimus is a library package which manages and displays tables of data. It is written in ANSI C and has been tested on a large number of computer architectures. Hippo has a number of design features which make it unique. Data is saved in a binary machine-independent format using the industry-standard XDR. Hippo supports graphics on many devices, but does not use any high-level graphics package. Even though it written in ordinary C, the functions are all coded in an "object-oriented" manner. All the display functions have been optimized to allow for maximum interactivity.

7502 (SLAC-PUB–5922) **HippoDraw.** Gravina, M.F.; Kunz, P.F.; Rensing, P.E. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Sep 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-920966–6: 10. conference on computing in high energy physics, Annecy (France), 21-25 Sep 1992). Order Number DE93004005. Source: OSTI; NTIS; INIS; GPO Dep.

HippoDraw is a NeXTSTEP application for viewing statistical data. It has several unique features which make viewing data distributions highly interactive. It also incorporates a set of simple drawing tools. HippoDraw is written in Objective-C and uses the Hippoplotamus library package to handle the n-tuples and displays.

7503 (SLAC-PUB–5923) **UNIX code management and distribution.** Hung, T.; Kunz, P.F. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Sep 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-920966–5: 10. conference on computing in high energy physics, Annecy (France), 21-25 Sep 1992). Order Number DE93004006. Source: OSTI; NTIS; INIS; GPO Dep.

We describe a code management and distribution system based on tools freely available for the UNIX systems. At the master site, version control is managed with CVS, which is a layer on top of RCS, and distribution is done via NFS mounted file systems. At remote sites, small modifications to CVS provide for interactive transactions with the CVS system at the master site such that remote developers are true peers in the code development process.

7504 (SOL–92-4) **Large-scale sequential quadratic programming algorithms.** Eldersveld, S.K. Stanford Univ., CA (United States). Systems Optimization Lab. Sep 1992. 91p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract FG03-92ER25117. Grant DDM-9204208;Grant N00014-90-J-1242. Order Number DE93002528. Source: OSTI; NTIS; GPO Dep.

The problem addressed is the general nonlinear programming problem: finding a local minimizer for a nonlinear function subject to a mixture of nonlinear equality and inequality constraints. The methods studied are in the class of sequential quadratic programming (SQP) algorithms, which have previously proved successful for problems of moderate size. Our goal is to devise an SQP algorithm that is applicable to large-scale optimization problems, using sparse data structures and storing less curvature information but maintaining the property of superlinear convergence. The main features are: 1. The use of a quasi-Newton approximation to the reduced Hessian of the Lagrangian function. Only an estimate of the reduced Hessian matrix is required by our algorithm. The impact of not having available the full Hessian approximation is studied and alternative estimates are constructed. 2. The use of a transformation matrix Q. This allows the QP gradient to be computed easily when only the reduced Hessian approximation is maintained. 3. The use of a reduced-gradient form of the basis for the null space of the working set. This choice of basis is more practical than an orthogonal null-space basis for large-scale problems. The continuity condition for this choice is proven. 4. The use of incomplete solutions of quadratic programming subproblems. Certain iterates generated by an active-set method for the QP subproblem are used in place of the QP minimizer to define the search direction for the nonlinear problem. An implementation of the new algorithm has been obtained by modifying the code MINOS. Results and comparisons with MINOS and NPSOL are given for the new algorithm on a set of 92 test problems.

7505 (VTT-TIED–1351) **CIM cell control.** Majapuro, R. (Technical Research Centre of Finland, Espoo (Finland). Lab. of Electrical and Automation Engineering); Hovi, A. Technical Research Centre of Finland, Espoo (Finland). 1992. 89p. (In Finnish). Order Number DE93752860. Source: OSTI; NTIS.

A frame solution for a flexible control software is developed in this research. It enables the combination of the production cells and built control software for cells using software modules. System changes can be made easily. The system is modular. The operations are grouped into operational units. Connections between units are defined when the production system is collected or when there are changes. In the structure the operation descriptions are differentiated from the implementation. The implementation is transparent to the user. The structure enables the user to assemble the production control by combining the library software modules like building blocks. The structure developed in the project is called VOU (Virtual Operative/Organizational Unit). The modularity of the structure enables the distribution of the system among inexpensive micro computers connected by LAN instead of using one expensive central computer. One micro computer can hold one or more operative units and the distribution is transparent to the application software. The frame of the structure is implemented using the newest software technology. It is programmed using OS/2 operating system. A graphical user interface and tool for figure preparation are a part of the frame implementation. The user interface is an independent operational unit using OS/2 Presentation Manager services. The user interface is universal. Operations describe to the user interface how to represent operation parameters and themselves. There can be several user interfaces in the system. Interfaces can send and request information to and from all units in different pc:s transparently.

7506 (WHC-EP–0588) **Smart card technology.** Nelson, R.A. Westinghouse Hanford Co., Richland, WA (United States). Sep 1992. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE93004490. Source: OSTI; NTIS; GPO Dep.

This report describes smart card techonology and applications, including the use of smart cards as smart badges. The paper illustrates that smart cards are designed with security features, which makes them suitable for security applications. But smart cards also provide multiple functions, so they can support additional applications. The goal of this paper is to inform about the technology, and to inspire thought about possible applications that would benefit if a smart badge were implemented.

9903 Information Handling

Refer also to citation(s) 5026, 5445, 5454, 5728, 5939, 6468, 6521, 6576, 6699, 7418, 7448, 7458

7507 (CONF-9110197–4) **Knowledge acquisition for group problem solving.** Williams, K.E.; Deighan, J.; Kotnour, T. Virginia Polytechnic Inst. and State Univ., Blacksburg, VA (United States). Management Systems Labs. [1991]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91NP00119. (CONF-9203207–1: American Society for Engineering Management annual conference; 14. conference on computers and industrial engineering, Chattanooga, TN (United States); Cocoa Beach, FL (United States), 20-22 Oct 1991; 9-11 mar 1992). Order Number DE93004149. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The tasks faced by contemporary and future managers are and will be increasingly complex and cognitive in nature. In fact, most managers are faced with the management of the knowledge bases of groups of individuals possessing specialized knowledge in a variety of domains. Eliciting, representing, organizing, integrating, constraining and evaluating these collective knowledge sources are required for accurate problem solving and decision making in the manager's environment. Given the complexity of these cognitive activities, computerized systems for group problem solving (GPSS) and group decision support (GDSS) have emerged, An existing problem with these systems is the lack of facility with which knowledge can be elicited, organized, and integrated for problem solving and decision making activities. The research presented in this paper describes an automated knowledge acquisition capability based upon a cognitive complexity analysis for generating problem representations from which decisions and problem solutions can be made. The problem solving process described is consistent with an information processing model of problem solving which can be applied to group and individual applications and serves as a core architecture for the development of an information center.

7508 (CONF-9210158–3) **SGML encoding for technical reports.** Mason, J.D. Oak Ridge National Lab., TN (United States). [1992]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Infotech '92; Oak Ridge, TN (United States); 21-23 Oct 1992. Order Number DE93003087. Source: OSTI; NTIS; GPO Dep.

The author discusses factors to be considered in the incorporation of Standard Generalized Markup Language (SGML) by DOE facilities in their processes of generating and distributing technical reports. A generalized new outlook in information handling is proposed, along with pertinent methodological particulars. The standardization of terminology and special notations are considered. An overall plan that entails the needs of both data compilation and information retrieval is initiated.

7509 (CONF-930373–1) **Applications of neural networks in polymer simulations.** Noid, D.W. (Oak Ridge National Lab., TN (United States)); Darsey, J.A.; Sumpter, B.G. Oak Ridge National Lab., TN (United States). [1992]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Society of Plastic Engineers (SPE) meeting; New Orleans, LA (United States); 22-26 Mar 1993. Order Number DE93004110. Source: OSTI; NTIS; GPO Dep.

The simulation of polymer properties and dynamics has always represented a grand challenge for current computers. The reasons for this are twofold: (1) to have the unique properties of polymers involves the molecular bonding of thousands of atoms, and (2) the time scale of interest for most polymer processes is quite long relative to the vibrational periods. Current work on polymer dynamics in our laboratory consists of molecular dynamics simulations of systems with >10,000 atoms which requires extensive computer calculations on supercomputers. A large effort is needed to make these calculations and even more realistic simulations (with larger systems) feasible. One approach is to develop methods which can be mapped on new parallel computers such as Kendall Square, Hypercube, Connection machine, etc. Another approach is to develop new methodologies which can supplement current molecular dynamics simulations. For the past few years, we have been formulating new techniques for polymer dynamics. Some of this work has involved utilizing new spectral methods, geometric statement functions, and more recently neural networks. In this paper, we discuss results and simulations obtained by combining neural networks with molecular dynamics simulations.

7510 (DOE/DP/48075–3) **Establishment of review groups on US Department of Energy Environmental Restoration and Waste Management Program: Final report.** Eyman, L.D. Waste Policy Inst., Blacksburg, VA (United States). Dec 1992. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG07-89DP48075. Order Number DE93005057. Source: OSTI; NTIS; INIS; GPO Dep.

A primary purpose of this grant was the establishment of expert research review groups to help facilitate expanded and improved communications and information among states, public, federal agencies, contractors, and DOE, relative to national environmental and waste management issues/problems. The general objectives of this grant were: Research on the further participation avenues of industry and academia and provide appropriate research documentation concerning the implementation of multi-party agreements; Analysis of the impediments that delay the accomplishment of agreements between states and the federal government for environmental compliance, as well as an assessment of the public need for research because of the above agreements; Analysis of the impact of environmental actions on states, industry, academia, public and other federal agencies; Provide research to help facilitate an interactive system that provides the various involved parties the capability and capacity to strengthen their commitment to national environmental and waste management goals and objectives; and Furthering research of public education in the environmental arena and research of needed national education resources in scientific and technical areas related to environmental restoration and waste management.

7511 (SAND–92-1903C) **Treatment of human-computer interface in a decision support system.** Heger, A.S. (New Mexico Univ., Albuquerque, NM (United States). Dept. of Chemical and Nuclear Engineering); Duran, F.A.; Frysinger, S.; Cox, R.G. Sandia National Labs., Albuquerque, NM (United States). [1992]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9210177–2: 1992 Institute of Electrical and Electronic Engineers (IEEE) system, man and cybernetics conference, Chicago, IL (United States), 18-21 Oct 1992). Order Number DE93002281. Source: OSTI; NTIS; INIS; GPO Dep.

One of the most challenging applications facing the computer community is development of effective adaptive human-computer interface. This challenge stems from the complex nature of the human part of this symbiosis. The application of this discipline to the environmental restoration and waste management is further complicated due to the nature of environmental data. The information that is required to manage environmental impacts of human activity is fundamentally complex. This paper will discuss the efforts at Sandia National Laboratories in developing the adaptive conceptual model manager within the constraint of the environmental decision-making. A computer workstation, that hosts the Conceptual Model Manager and the Sandia Environmental Decision Support System will also be discussed.

7512 (SA-PUB–3/92, pp. 256-257) **A geographic information system for SILMU.** Alm, J. (Joensuu Univ. (Finland). Dept. of Biology); Lampinen, R. Academy of Finland, Helsinki (Finland). 1992. In *The Finnish research programme on climate change: Progress report.* 310p. Order Number DE93752870. Source: OSTI; NTIS.

SILMU Research Programme.

The Finnish Research Programme on Climate Change (SILMU) provides an interesting framework for multidisciplinary approaches in the field of regional environmental studies. Access to various national databases, owned by many organisations, can be made possible in cooperation with the many SILMU research groups. As a result of their work the research groups may also produce spatial data or models, which could be integrated in GIS and thus readily benefited by SILMU. Many research organisations are, however, lacking in advanced spatial data processing tools (GIS) hardware and (software), as well as trained personnel. Application of GIS for spatial natural resource management and environmental questions is now increasing in Finland, following technical development and affordability of the tools. The current undertaking is formally considered as a systems development project, the definition part of which was completed during a pilot study in 1991. The main result of the pilot study was that no large, multipurpose database should be built for SILMU, neither was a 'complete solution' for GIS research attainable. This was due to the scattered needs for data and, probably, a lack of previous experience and funding for GIS in the research organisations. The aim of this project is to provide tools and advice for any SILMU project to analyse their own spatial questions and fat in a GIS. This is accomplished by building a kernel GIS database in a working system and a GIS expert node. Consequently, any research group taking part in SILMU will be able to include their own data, or model, in the system with minimum effort.

7513 (SLAC-PUB–5930) **The Cheetah data management system.** Kunz, P.F. (Stanford Linear Accelerator Center, Menlo Park, CA (United States)); Word, G.B. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Sep 1992. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-920966–3: 10. conference on computing in high energy physics, Annecy (France), 21-25 Sep 1992). Order Number DE93004010. Source: OSTI; NTIS; INIS; GPO Dep.

Cheetah is a data management system based on the C programming language, with support for other languages. Its main goal is to transfer data between memory and I/O steams in a general way. The streams are either associated with disk files or are network data stems. Cheetah provides optional convenience functions to assist in the management of C structures. Cheetah steams are self-describing so that general purpose applications can fully understand an incoming steam. This information can be used to display the data in an incoming steam to the user of an interactive general application, complete with variable names and optional comments.

7514 (UM-P–91/111) **Microcomputer based acquisition system for the Philips PW1306/00 powder diffractometer.** Grigg, M.W.; Keating, A.; Brockwell, A.; Barnea, Z. Melbourne Univ., Parkville, VIC (Australia). School of Physics. [1992]. [4] Sponsored by Australian Research Council, Canberra, ACT (Australia). Order Number DE93609809. Source: OSTI; NTIS (US Sales Only); INIS.

A simple and cost effective system for converting the output from the Philips PW1306/00 powder diffractometer into a digital form suitable for recording and analysis by a personal computer is described. 1 fig.

9904 Law

Refer also to citation(s) 5433

7515 (INIS-XN–396) **16 October 1991-Royal Order amending the Royal Order of 30 March 1981 determining the duties and fixing the operating conditions of the Public Body for the Management of Radioactive Waste and Fissile Materials.** Belgium. 22 Nov 1991. [9] (In French, Dutch). Order Number DE93609767. Source: OSTI; NTIS (US Sales Only); INIS.

The 1991 Royal Order amends and supplements the provisions of the 1981 Order dealing with the duties and resources of ONDRAF, the National Body for the Management of Radioactive Waste and Fissile Materials. Its duties include, inter alia, treatment and conditioning of waste on behalf of producers without the necessary facilities, training of specialists for such work for the producers with such facilities, transport, storage and disposal of radioactive waste, transport, and storage of certain enriched fissile materials and plutonium-bearing materials. As regards decommissioned nuclear installations, ONDRAF must establish management programmes for the resulting waste and must also decommission a nuclear installation at the operator's request or if he defaults. (NEA).

7516 (INIS-XN–397) **12 November 1991-Ministerial Order setting up a Commission for assessing information in the nuclear field.** Belgium. 11 Dec 1991. [2] (In French, Dutch). Order Number DE93609768. Source: OSTI; NTIS (US Sales Only); INIS.

The Commission sets up by this Order must ensure that the public is kept informed on the technical, health, ecological, economic and financial aspects of nuclear energy, and advises the Secretary of State for Energy on the conditions for informing the public and proposes methods for disseminating such information. (NEA).

7517 (INIS-XN–407) **Ministry of the Environment and Natural Resources-Decree-Law No.425/91 of 30 October.** Portugal. 30 Oct 1991. [6] (In Portuguese). Order Number DE93609769. Source: OSTI; NTIS (US Sales Only); INIS.

This Decree-Law restructures the Nuclear Protection and Safety Bureau to take account of its new responsibilities. It has the following tasks: evaluates and monitors the radiological impact of nuclear and radioactive installations, the safe management of radioactive waste; safety of nuclear and radioactive installations; controls that measures in the field of third party liability and nuclear non-proliferation are complied with; and co-operates with national and international authorities to respond to nuclear and radiological emergencies. (NEA).

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AC02-76ER03075	**Los Alamos National Lab., NM (United States)**	
	18:6878	LA-UR–92-3479
AC02-78ET51013	**Oak Ridge National Lab., TN (United States)**	
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AC02-79ET10815	**Tennessee Univ., Tullahoma, TN (United States). Space Inst.**	
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AC02-80ER10774	**Iowa State Univ. of Science and Technology, Ames, IA (United States)**	
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AC02-80ET15601	**Mississippi State Univ., MS (United States). Diagnostic Instrumentation and Analysis Lab.**	
	18:5761	DOE/ET/15601–43
AC02-83CH10093	**National Renewable Energy Lab., Golden, CO (United States)**	
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AC02-86NE37964	**Northeastern Univ., Boston, MA (United States)**	
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AC02-87ER40372	**Notre Dame Univ., IN (United States). Dept. of Physics**	
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AC02-88ER80591	**CeraMem Corp., Waltham, MA (United States)**	
	18:4845	DOE/ER/80591–93/C0126
AC02-89CE40874	**Surface Combustion, Inc., Maumee, OH (United States)**	
	18:5936	DOE/CE/40874–3
AC02-89CE40917	**Air Products and Chemicals, Inc., Allentown, PA (United States)**	
	18:6046	DOE/CE/40917–T2
AC02-89CH10378	**RE/SPEC, Inc., Rapid City, SD (United States)**	
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AC02-90ER40579	**Pennsylvania State Univ., University Park, PA (United States)**	
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AC03-76SF00098	**Sandia National Labs., Albuquerque, NM (United States)**	
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	Los Alamos National Lab., NM (United States)	
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AC03-76SF00515	**Stanford Linear Accelerator Center, Menlo Park, CA (United States)**	
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AC03-89ER51114	**General Atomics, San Diego, CA (United States)**	
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AC03-89ER53277	**General Atomics, San Diego, CA (United States)**	
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AC03-91SF18852	General Electric Co., Philadelphia, PA (United States). Astro Space Div.	
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AC04-76DP00613	Allied-Signal Aerospace Co., Kansas City, MO (United States). Kansas City Div.	
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AC04-76DP00789	Sandia National Labs., Albuquerque, NM (United States)	
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AC04-85AL25763	Rockwell International Corp., Canoga Park, CA (United States). Rocketdyne Div.	
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AC04-86AL31950	Westinghouse Electric Corp., Carlsbad, NM (United States). Waste Isolation Div.	
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AC04-86ID12584	Chem-Nuclear Geotech, Inc., Grand Junction, CO (United States)	
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AC04-87ID12624	Dow Corning Corp., Midland, MI (United States)	
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AC04-88DP43495	EG and G Mound Applied Technologies, Miamisburg, OH (United States)	
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AC04-88ID12692	Minnesota Mining and Mfg. Co., St. Paul, MN (United States). Corporate Research Labs.	
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AC05-76OR00001	Portsmouth Gaseous Diffusion Plant, OH (United States)	
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	Martin Marietta Energy Systems, Inc., Piketon, OH (United States)	
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AC05-76OR00033	Oak Ridge Associated Universities, Inc., TN (United States)	
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AC05-84ER40150	Continuous Electron Beam Accelerator Facility, Newport News, VA (United States)	
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	18:5618	HW–56816-RD
	18:6098	HW–30589-Pt.1
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	18:5198	PNL–8419
	18:5199	PNL-SA–20868
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	18:5824	PNL–8218
	18:6218	PNL–8455
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	18:6788	PNL–8416
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AC06-86NE37963	**Oregon Graduate Inst. of Science and Technology, Beaverton, OR (United States)**	
	18:5943	DOE/NE/37963–21
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AC06-87RL10930	**Westinghouse Hanford Co., Richland, WA (United States)**	
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	18:5598	WHC-SA–1586
	18:5599	WHC-SP–0839
	18:5659	WHC-SP–0300
	18:5765	WHC-SA–1590
	18:6225	WHC-SA–1606
	18:6595	WHC-EP–0554
	18:7436	WHC-SP–0708
	18:7458	ESTSC–000435CY0MP00
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AC08-89NV10755	Nuclear Regulatory Commission, Washington, DC (United States). Div. of Regulatory Applications	
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AC08-90NV10845	Nevada Univ., Reno, NV (United States). Water Resources Center	
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AC08-91NV10833	USDOE Nevada Field Office, Las Vegas, NV (United States)	
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AC09-76SR00001	Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Atomic Energy Div.	
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	18:5495	DPW–53-614
	18:5614	DPW–53-676
	18:6672	DPW–53-129
AC09-76SR00819	Savannah River Ecology Lab., Aiken, SC (United States)	
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AC09-89SR18035	Du Pont de Nemours (E.I.) and Co., Aiken, SC (United States). Savannah River Plant	
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	Westinghouse Savannah River Co., Aiken, SC (United States)	
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	18:7051	WSRC-TR–91-503
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AC21-86MC21023	Foster Wheeler Development Corp., Livingston, NJ (United States)	
	18:4939	DOE/MC/21023–93/C0086
AC21-86MC22118	Radian Corp., Austin, TX (United States)	
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AC21-86MC23075	Advanced Fuel Research, Inc., East Hartford, CT (United States)	
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AC21-86MC23252	Westinghouse Electric Corp., Pittsburgh, PA (United States). Science and Technology Center	
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AC21-87MC24116	Coal Technology Corp., Bristol, VA (United States)	
	18:4856	DOE/MC/24116–93/C0109
AC21-87MC24257	Westinghouse Electric Corp., Pittsburgh, PA (United States). Science and Technology Center	
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AC21-88MC24221	International Fuel Cells Corp., South Windsor, CT (United States)	
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AC21-88MC25003	General Electric Co., Schenectady, NY (United States). Corporate Research and Development Center	
	18:4858	DOE/MC/25003–93/C0090
AC21-88MC25006	Research Triangle Inst., Research Triangle Park, NC (United States)	
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AC21-88MC25020	Lummus Crest, Inc., Bloomfield, NJ (United States)	
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AC21-88MC25034	Westinghouse Electric Corp., Pittsburgh, PA (United States). Science and Technology Center	
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AC21-88MC25201	Acurex Environmental Corp., Mountain View, CA (United States)	
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AC21-88MC25204	SRI International, Menlo Park, CA (United States)	
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AC21-89MC25115	BDM Engineering Services Co., McLean, VA (United States)	
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AC21-89MC26052	United Technologies Corp., East Hartford, CT (United States). Research Center	
	18:5861	DOE/MC/26052–3140
AC21-89MC26239	Southern Research Inst., Birmingham, AL (United States)	
	18:4867	DOE/MC/26239–93/C0133
AC21-89MC26355	Westinghouse Electric Corp., Pittsburgh, PA (United States). Science and Technology Center	
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AC21-89MC26366	Louisiana State Univ., Baton Rouge, LA (United States). Dept. of Chemical Engineering	
	18:4870	DOE/MC/26366–93/C0102
AC21-89MC26372	Worcester Polytechnic Inst., MA (United States)	
	18:4871	DOE/MC/26372–93/C0103
AC21-89MC26373	SRI International, Menlo Park, CA (United States)	
	18:6096	DOE/MC/26373–93/C0104
AC21-90MC26038	Air Products and Chemicals, Inc., Allentown, PA (United States)	
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AC21-90MC26328	USDOE Morgantown Energy Technology Center, WV (United States)	
	18:4884	DOE/METC/C–93/7040

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AC21-90MC26365	**California Inst. of Tech., Pasadena, CA (United States)**	
	18:4869	DOE/MC/26365–93/C0099
AC21-90MC27224	**Research Triangle Inst., Research Triangle Park, NC (United States)**	
	18:4872	DOE/MC/27224–93/C0089
AC21-90MC27226	**ARCTECH, Inc., Chantilly, VA (United States)**	
	18:4873	DOE/MC/27226–93/C0108
AC21-90MC27227	**Energy Research Corp., Danbury, CT (United States)**	
	18:4874	DOE/MC/27227–93/C0130
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AC21-90MC27423	**Combustion Power Co., Inc., Menlo Park, CA (United States)**	
	18:5359	DOE/MC/27423–93/C0095
AC21-91MC27233	**Kellogg (M.W.) Co., Houston, TX (United States)**	
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AC21-91MC27240	**SGI Fuels, Inc., La Jolla, CA (United States)**	
	18:4876	DOE/MC/27240–93/C0115
AC21-91MC27259	**Westinghouse Electric Corp., Pittsburgh, PA (United States). Science and Technology Center**	
	18:5358	DOE/MC/27259–93/C0094
AC21-92MC28202	**CRS Sirrine Engineers, Inc., Greenville, SC (United States)**	
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AC22-86PC90258	**Energy International Corp., Pittsburgh, PA (United States)**	
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AC22-87PC79672	**TRW, Inc., Redondo Beach, CA (United States). Applied Technology Div.**	
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AC22-88PC88812	**Colorado School of Mines, Golden, CO (United States). Dept. of Chemical Engineering and Petroleum Refining**	
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AC22-89PC89883	**Consolidation Coal Co., Library, PA (United States). Research and Development Dept.**	
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AC22-90PC90033	**Southern Co. Services, Inc., Birmingham, AL (United States)**	
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AC22-90PC90038	**Southern Research Inst., Birmingham, AL (United States)**	
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AC22-90PC90098	**Textron, Inc., Everett, MA (United States). Textron Defense Systems**	
	18:5343	DOE/PC/90098–T7
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AC22-90PC90363	**Energy and Environmental Research Corp., Irvine, CA (United States)**	
	18:4954	DOE/PC/90363–T6
AC22-91PC90182	**Florida Univ., Gainesville, FL (United States)**	
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AC22-91PC90185	**Worcester Polytechnic Inst., MA (United States)**	
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AC22-91PC91026	**Advanced Fuel Research, Inc., East Hartford, CT (United States)**	
	18:4889	DOE/PC/91026–T5
AC22-91PC91039	**SRI International, Menlo Park, CA (United States)**	
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AC22-91PC91042	**Pennsylvania State Univ., University Park, PA (United States). Dept. of Materials Science and Engineering**	
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AC22-91PC91161	**Vortec Corp., Collegeville, PA (United States)**	
	18:4955	DOE/PC/91161–T2
AC22-92PC91155	**United Technologies Research Center, East Hartford, CT (United States)**	
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AC22-92PC92151	**Little (Arthur D.), Inc., Cambridge, MA (United States)**	
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AC34-90DP62349	**EG and G Rocky Flats, Inc., Golden, CO (United States)**	
	18:5201	RFP–4645
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AC35-89ER40486	**Superconducting Super Collider Lab., Dallas, TX (United States)**	
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AI01-85CE50111	**National Aeronautics and Space Administration, Cleveland, OH (United States). Lewis Research Center**	
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AI01-86CE90213	**National Inst. of Standards and Technology, Gaithersburg, MD (United States). Chemical Process Metrology Div.**	
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	18:6188	DOE/CE/90213–T7
AI01-91CE50306	**National Aeronautics and Space Administration, Cleveland, OH (United States). Lewis Research Center**	
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AI01-92EI22935	**Geological Survey, Reston, VA (United States)**	
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AI05-84ER40156	**Naval Research Lab., Washington, DC (United States)**	
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AI05-86ER25016	**National Science Foundation, Washington, DC (United States)**	
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AI05-86OR21674	**Geological Survey, Nashville, TN (United States)**	
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AI06-91RL12253	**Westinghouse Hanford Co., Richland, WA (United States)**	
	18:5173	WHC-SD-WM-ES–219

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AT03-76ER70023	Stanford Linear Accelerator Center, Menlo Park, CA (United States)	
	18:6433	SLAC-PUB–5945
FC01-89CH10402	Council of State Governments, Lombard, IL (United States). Midwestern Office	
	18:5110	DOE/CH/10402–18
	18:5111	DOE/CH/10402–19
FC01-91EI22790	Missouri Dept. of Natural Resources, Jefferson City, MO (United States). Div. of Energy	
	18:4990	DOE/EI/22790–T1
FC02-88ID12726	Solar Energy Research Inst., Golden, CO (United States)	
	18:5816	DOE/ID/12726–T4
FC02-89ID12905	Georgia Inst. of Tech., Atlanta, GA (United States). Georgia Technology Research Inst.	
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FC02-89ID12917	Purdue Univ., Lafayette, IN (United States). Dept. of Agricultural Engineering	
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FC03-90ER61010	National Inst. for Global Environmental Change, Davis, CA (United States)	
	18:6610	DOE/ER/61010–1
	Harvard Univ., Cambridge, MA (United States). Law School	
	18:6473	DOE/ER/61010–2
FC05-85ER25000	Argonne National Lab., IL (United States). High Energy Physics Div.	
	18:6889	ANL-HEP-CP–92-113
FC07-89ID12869	American Foundrymen's Society, Des Plaines, IL (United States)	
	18:5942	DOE/ID/12869–T1
FC07-90ID12945	University of Southwestern Louisiana, Lafayette, LA (United States). Acadiana Research Lab.	
	18:5310	DOE/ID/12945–T6
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FC09-86SR15160	South Carolina Water Resources Commission, Columbia, SC (United States)	
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FC21-86LC11084	Wyoming Univ., Laramie, WY (United States). Environmental Simulation Lab.	
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FC21-86MC10637	North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center	
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FC21-86MC11076	Western Research Inst., Laramie, WY (United States)	
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FC21-87MC23277	Texaco, Inc., Montebello, CA (United States). Montebello Research Lab.	
	18:4855	DOE/MC/23277–93/C0087
FC21-89MC25137	Colorado-Ute Electric Association, Inc., Montrose, CO (United States)	
	18:4940	DOE/MC/25137–3104
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FC21-90MC25140	Southern Co. Services, Inc., Birmingham, AL (United States)	
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FC21-90MC27339	Encoal Corp., Gillette, WY (United States)	
	18:4877	DOE/MC/27339–93/C0112
FC21-91MC26308	Combustion Engineering, Inc., Windsor, CT (United States)	
	18:4868	DOE/MC/26308–93/C0081
FC21-91MC27363	Tampa Electric Co., FL (United States)	
	18:4878	DOE/MC/27363–93/C0082
FC21-91MC27364	Iowa Power, Inc., Des Moines, IA (United States)	
	18:4942	DOE/MC/27364–93/C0078
FC21-91MC28055	Westinghouse Electric Corp., Pittsburgh, PA (United States). Science and Technology Center	
	18:5769	DOE/MC/28055–93/C0135
FC21-92MC27391	Kerr-McGee Coal Corp., Oklahoma City, OK (United States)	
	18:4879	DOE/MC/27391–93/C0110
FC21-92MC29309	Sierra Pacific Power Co., Reno, NV (United States)	
	18:5339	DOE/MC/29309–93/C0083
FC21-92MC29310	Wabash Coal Gasification Repowering Project Joint Venture, Houston, TX (United States)	
	18:4881	DOE/MC/29310–93/C0084
FC21-93MC29444	TAMCO Power Partners, Marietta, GA (United States)	
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FC22-83FE60149	National Inst. for Petroleum and Energy Research, Bartlesville, OK (United States)	
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FC22-87PC79796	Energy and Environmental Research Corp., Irvine, CA (United States)	
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FC22-87PC79798	Babcock and Wilcox Co., Barberton, OH (United States). Boiler Div.	
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FC22-90PC89652	Southern Co. Services, Inc., Birmingham, AL (United States)	
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FC22-90PC89659	Babcock and Wilcox Co., Cassville, WI (United States)	
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FG01-88CE50280	Hawaii Natural Energy Inst., Honolulu, HI (United States)	
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FG01-89CE15361	Rutgers–the State Univ., Piscataway, NJ (United States). Dept. of Mechanical and Aerospace Engineering	
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FG01-89CE28313	Energy and Solid Waste Consultants, Montpelier, VT (United States)	
	18:5794	DOE/CE/28313–T2
FG01-90CE15459	S-Cal Research Corp., San Rafael, CA (United States)	
	18:5016	DOE/CE/15459–T5
FG01-90CE26603	TECOGEN, Inc., Waltham, MA (United States)	
	18:5838	DOE/CE/26603–T2

Contract No.	Abstract No.	Report No.
FG01-90ER81079	Argonne National Lab., Idaho Falls, ID (United States)	
	18:5916	ANL/FE/CP–75641
FG01-92CE15503	Plaur Corp., Philadelphia, PA (United States)	
	18:5935	DOE/CE/15503–T2
FG01-92CE15533	Energy Recovery Technology, Salt Lake City, UT (United States)	
	18:5024	DOE/CE/15533–T1
FG01-92CE15553	S-Cal Research Corp., San Rafael, CA (United States)	
	18:4977	CONF-920383–3
FG01-92RW00264	Western Network, Santa Fe, NM (United States)	
	18:5139	DOE/RW/00264–T2
FG02-78IR05106	Urban Consortium for Technology Initiatives (United States). Energy Task Force	
	18:5843	DOE/IR/05106–2-Vol.2
	18:5844	DOE/IR/05106–4
	18:5845	DOE/IR/05106–6
	18:5846	DOE/IR/05106–T161
	18:5902	DOE/IR/05106–T160
FG02-84ER45120	Seton Hall Univ., South Orange, NJ (United States). Dept. of Chemistry	
	18:6135	DOE/ER/45120–11
FG02-84ER45130	Forschungszentrum Juelich GmbH (Germany). Inst. fuer Festkoerperforschung	
	18:5930	CONF-920762–8
FG02-84ER52111	Illinois Univ., Urbana, IL (United States). Fusion Technology Lab.	
	18:7375	DOE/ER/52111–5
FG02-85ER13331	Massachusetts Inst. of Tech., Cambridge, MA (United States). Energy Lab.	
	18:6197	DOE/ER/13331–T4
FG02-85ER40213	Argonne National Lab., IL (United States). High Energy Physics Div.	
	18:6889	ANL-HEP-CP–92-113
FG02-85ER45188	Pennsylvania Univ., Philadelphia, PA (United States)	
	18:5938	DOE/ER/45188–8
FG02-85ER45223	Northeastern Univ., Boston, MA (United States). Dept. of Physics	
	18:6008	DOE/ER/45223–1
FG02-86ER13480	Princeton Univ., NJ (United States). Dept. of Chemistry	
	18:6125	DOE/ER/13480–3
FG02-86ER13504	Rochester Univ., NY (United States)	
	18:6167	DOE/ER/13504–7
FG02-86ER13529	Ohio State Univ., Columbus, OH (United States). Dept. of Chemistry	
	18:6126	DOE/ER/13529–7
FG02-86ER13549	Pennsylvania State Univ., University Park, PA (United States)	
	18:7065	DOE/ER/13549–7
FG02-86ER13580	Lehigh Univ., Bethlehem, PA (United States)	
	18:4844	DOE/ER/13580–T2
FG02-86ER13610	MCR Technology Corp., Chicago, IL (United States)	
	18:6443	CONF-8809281–3
FG02-86ER40302	Colorado Univ., Boulder, CO (United States). Dept. of Astrophysical, Planetary, and Atmospheric Sciences	
	18:6293	DOE/ER/40302–7
FG02-86ER53216	Wisconsin Univ., Madison, WI (United States)	
	18:7158	DOE/ER/53216–13
FG02-86ER53218	Wisconsin Univ., Madison, WI (United States). Dept. of Electrical and Computer Engineering	
	18:7159	DOE/ER/53218–21
FG02-86ER60401	Illinois Univ., Urbana, IL (United States)	
	18:6642	DOE/ER/60401–3
FG02-86SF16306	Colorado State Univ., Fort Collins, CO (United States). Solar Energy Applications Lab.	
	18:5289	DOE/SF/16306–34
FG02-87ER13649	Syracuse Univ., NY (United States). Dept. of Chemical Engineering and Materials Science	
	18:6127	DOE/ER/13649–T2
FG02-87ER13654	Northwestern Univ., Evanston, IL (United States)	
	18:6128	DOE/ER/13654–6
FG02-87ER13690	Pennsylvania State Univ., University Park, PA (United States)	
	18:5238	DOE/ER/13690–5
FG02-87ER13764	Wisconsin Univ., Milwaukee, WI (United States). Dept. of Mechanical Engineering	
	18:6233	DOE/ER/13764–10
FG02-87ER13766	Purdue Univ., Lafayette, IN (United States). Dept. of Chemistry	
	18:6168	DOE/ER/13766–10
FG02-87ER13777	Johns Hopkins Univ., Baltimore, MD (United States). Dept. of Chemical Engineering	
	18:6129	DOE/ER/13777–5
FG02-87ER60524	Michigan State Univ., East Lansing, MI (United States). Carcinogenesis Lab.	
	18:6668	DOE/ER/60524–6
FG02-87ER60592	New York Univ., NY (United States). Medical Center	
	18:6669	DOE/ER/60592–9
FG02-88ER12810	Northwestern Univ., Evanston, IL (United States). Dept. of Mechanical Engineering	
	18:5446	CONF-910414–38
	18:5447	CONF-910414–39
FG02-88ER13836	Yale Univ., New Haven, CT (United States). Dept. of Chemical Engineering	
	18:6130	DOE/ER/13836–5
FG02-88ER13935	Iowa Univ., Iowa City, IA (United States). Dept. of Chemistry	
	18:6132	DOE/ER/13935–T1
FG02-88ER13952	International Basement Tectonics Association, Inc., Salt Lake City, UT (United States)	
	18:6794	DOE/ER/14201–1
FG02-88ER40406	Washington Univ., St. Louis, MO (United States). Dept. of Chemistry	
	18:6986	DOE/ER/40406–5
FG02-88ER40417	Brookhaven National Lab., Upton, NY (United States)	
	18:6961	BNL–48044
FG02-88ER40448	Rensselaer Polytechnic Inst., Troy, NY (United States). Dept. of Physics	
	18:6951	DOE/ER/40448–5
FG02-88ER53264	Wisconsin Univ., Madison, WI (United States). Dept. of Nuclear Engineering and Engineering Physics	
	18:7376	DOE/ER/53264–3
FG02-88ER60648	Pennsylvania State Univ., University Park, PA (United States)	
	18:6137	DOE/ER/60648–5
FG02-88ER60678	Chicago Univ., IL (United States)	
	18:6670	DOE/ER/60678–5

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FG02-88ER60688	Harvard Medical School, Boston, MA (United States). Dept. of Biological Chemistry and Molecular Pharmacology	
	18:6635	DOE/ER/60688–5
FG02-88ER60691	Massachusetts Inst. of Tech., Cambridge, MA (United States)	
	18:6639	DOE/ER/60691–1
FG02-89ER12889	Pennsylvania State Univ., University Park, PA (United States). Coll. of Engineering	
	18:5471	DOE/ER/12889–14
	Pennsylvania State Univ., University Park, PA (United States). Dept. of Nuclear Engineering	
	18:5468	CONF-9104287–2
FG02-89ER14035	Massachusetts Inst. of Tech., Cambridge, MA (United States). Dept. of Chemistry	
	18:5937	DOE/ER/14035–T2
FG02-89ER45404	Carnegie-Mellon Univ., Pittsburgh, PA (United States). Dept. of Mechanical Engineering	
	18:6048	DOE/ER/45404–3
FG02-90CE15988	Ferris State Univ., Big Rapids, MI (United States). Technology Transfer Center	
	18:5725	DOE/CE/15988–T1
FG02-90CE27504	Urban Consortium for Technology Initiatives (United States). Energy Task Force	
	18:5236	DOE/CE/27504–11
	18:5677	DOE/CE/27504–8
	18:5791	DOE/CE/27504–4
	18:5792	DOE/CE/27504–T1
	18:5793	DOE/CE/27504–T2
	18:5839	DOE/CE/27504–3
	18:5840	DOE/CE/27504–10
	18:5841	DOE/CE/27504–13-Pt.2
	18:5898	DOE/CE/27504–2
	18:5899	DOE/CE/27504–5
	18:5900	DOE/CE/27504–12
	18:6260	DOE/CE/27504–9
FG02-90ER12102	Arizona Univ., Tucson, AZ (United States). Optical Sciences Center	
	18:5005	DOE/ER/12102–1
FG02-90ER12105	Brigham Young Univ., Provo, UT (United States)	
	18:7154	DOE/ER/12105–2
FG02-90ER12930	Massachusetts Inst. of Tech., Cambridge, MA (United States). Nuclear Reactor Lab.	
	18:5472	DOE/ER/12930–1
FG02-90ER14105	Ohio State Univ., Columbus, OH (United States). Dept. of Chemistry	
	18:6169	DOE/ER/14105–3
FG02-90ER14128	Cornell Univ., Ithaca, NY (United States)	
	18:6190	DOE/ER/14128–2
FG02-90ER14130	Wisconsin Univ., Milwaukee, WI (United States)	
	18:6047	DOE/ER/14130–2
FG02-90ER14135	Battelle, Columbus, OH (United States)	
	18:5933	CONF-921110–42
FG02-90ER40577	Pennsylvania State Univ., University Park, PA (United States). Dept. of Physics	
	18:6896	DOE/ER/40577–3
FG02-90ER45423	Carnegie-Mellon Univ., Pittsburgh, PA (United States)	
	18:5939	DOE/ER/45423–3
FG02-90ER45427	Argonne National Lab., IL (United States)	
	18:5998	ANL/CP–77481
	18:5999	ANL/CP–77533
	Purdue Univ., Lafayette, IN (United States)	
	18:7129	DOE/ER/45427–3
FG02-90ER54084	Massachusetts Inst. of Tech., Cambridge, MA (United States)	
	18:7377	DOE/ER/54084–T1
FG02-90ER61029	Clarkson Univ., Potsdam, NY (United States). Dept. of Chemistry	
	18:6611	DOE/ER/61029–10
FG02-90ER80896	CeraMem Corp., Waltham, MA (United States)	
	18:4847	DOE/ER/80896–93/C0097
FG02-91CE23810	Akron Univ., OH (United States). Inst. of Polymer Science	
	18:6045	DOE/CE/23810–4C
	National Inst. of Standards and Technology, Gaithersburg, MD (United States). Thermophysics Div.	
	18:6044	DOE/CE/23810–4A
FG02-91ER12108	Illinois Univ., Chicago, IL (United States). Lab. for Atomic, Molecular, and Radiation Physics	
	18:6261	DOE/ER/12108–2
FG02-91ER12117	Rensselaer Polytechnic Inst., Troy, NY (United States). Dept. of Chemistry	
	18:5237	DOE/ER/12117–2
FG02-91ER14201	International Basement Tectonics Association, Inc., Salt Lake City, UT (United States)	
	18:6794	DOE/ER/14201–1
FG02-91ER20050	Pennsylvania State Univ., University Park, PA (United States)	
	18:6634	DOE/ER/20050–1
FG02-91ER25106	Front Range Scientific Computations, Inc., Boulder, CO (United States)	
	18:7452	DOE/ER/25106–1-Vol.1
	18:7453	DOE/ER/25106–1-Vol.2
FG02-91ER40608	Yale Univ., New Haven, CT (United States)	
	18:6963	DOE/ER/40608–2
FG02-91ER40609	Yale Univ., New Haven, CT (United States)	
	18:6964	DOE/ER/40609–2
FG02-91ER40628	Argonne National Lab., IL (United States). High Energy Physics Div.	
	18:6889	ANL-HEP-CP–92-113
FG02-91ER40661	Argonne National Lab., IL (United States). High Energy Physics Div.	
	18:6889	ANL-HEP-CP–92-113
FG02-91ER40669	Columbia Univ., New York, NY (United States). Dept. of Applied Physics	
	18:6323	CONF-9206193–18
FG02-91ER40672	Argonne National Lab., IL (United States). High Energy Physics Div.	
	18:6889	ANL-HEP-CP–92-113
FG02-91ER40684	Argonne National Lab., IL (United States). High Energy Physics Div.	
	18:6888	ANL-HEP-CP–92-109
FG02-91ER61192	Cornell Univ., Ithaca, NY (United States)	
	18:6612	DOE/ER/61192–1
FG02-91ER61204	Pittsburgh Univ., PA (United States). Dept. of Chemistry	
	18:6093	DOE/ER/61204–2
FG02-91ER61245	Eleanor Roosevelt Inst., Denver, CO (United States)	
	18:6640	DOE/ER/61245–1
FG02-91ER75639	East Tennessee Discovery Center, Knoxville, TN (United States)	
	18:5842	DOE/ER/75639–1
FG02-91ER75645	Discovery Center of Idaho, Boise, ID (United States)	
	18:5857	DOE/ER/75645–1

Contract No.	Abstract No.	Report No.
FG02-91ER75682	Kansas State Univ., Manhattan, KS (United States). Inst. for Social and Behavioral Research	
	18:5678	DOE/ER/75682–1-Pt.6
FG02-91NP00119	Virginia Polytechnic Inst. and State Univ., Blacksburg, VA (United States). Management Systems Labs.	
	18:7421	DOE/NP/00119–1
	18:7443	CONF-9110197–3
	18:7507	CONF-9110197–4
FG02-92CH10504	Society of Automotive Engineers, Inc., Warrendale, PA (United States)	
	18:5891	CONF-9209256–
FG02-92ER14262	Massachusetts Inst. of Tech., Cambridge, MA (United States). Dept. of Chemical Engineering	
	18:6609	DOE/ER/14262–1
FG02-92ER14283	Argonne National Lab., IL (United States). Physics Div.	
	18:7054	ANL/PHY/CP–77423
FG02-92ER40730	Argonne National Lab., IL (United States). High Energy Physics Div.	
	18:6914	ANL-HEP-CP–92-79
FG02-92ER54139	Wisconsin Univ., Madison, WI (United States). Dept. of Nuclear Engineering and Engineering Physics	
	18:7163	DOE/ER/54139–1
FG02-92ER61443	University of Southern Mississippi, Stennis Space Center, MS (United States)	
	18:6613	DOE/ER/61443–1
FG02-92ER61504	Wisconsin Univ., Madison, WI (United States). Dept. of Biochemistry	
	18:6638	CONF-9209255–Absts.
FG02-92ER81349	Industrial Filter and Pump Mfg. Co., Cicero, IL (United States)	
	18:5354	DOE/ER/81349–93/C0125
FG03-86ER52130	California Univ., Los Angeles, CA (United States)	
	18:7156	DOE/ER/52130–T3
FG03-86ER52134	California Univ., Los Angeles, CA (United States)	
	18:7157	DOE/ER/52134–T2
FG03-87ER45324	California Univ., Santa Cruz, CA (United States). Dept. of Physics	
	18:7081	DOE/ER/45324–T2
FG03-88ER53275	Science Applications International Corp., San Diego, CA (United States)	
	18:7162	DOE/ER/54071–T5
FG03-89ER14048	California Univ., Santa Barbara, CA (United States). Dept. of Chemical and Nuclear Engineering	
	18:6134	DOE/ER/14048–T4
FG03-89ER14053	University of Southern California, Los Angeles, CA (United States). Dept. of Chemistry	
	18:6189	DOE/ER/14053–T3
FG03-89ER51121	General Atomics, San Diego, CA (United States)	
	18:7380	GA-A–21044
	18:7381	GA-A–21045
FG03-90ER54071	Science Applications International Corp., San Diego, CA (United States)	
	18:7160	DOE/ER/54071–T3
	18:7161	DOE/ER/54071–T4
	18:7162	DOE/ER/54071–T5
FG03-90ER80998	TDA Research, Inc., Wheat Ridge, CO (United States)	
	18:4848	DOE/ER/80998–93/C0128
FG03-91ER12114	California Univ., Los Angeles, CA (United States). School of Engineering and Applied Science	
	18:7155	DOE/ER/12114–2
FG03-91ER20028	California Univ., Berkeley, CA (United States). Dept. of Plant Biology	
	18:6633	DOE/ER/20028–T2
FG03-91ER40662	California Univ., Los Angeles, CA (United States). Center for Advanced Accelerators Physics	
	18:6276	CONF-920837–24
	California State Univ., Los Angeles, CA (United States). Dept. of Physics and Astronomy	
	18:6383	CONF-920480–2
FG03-91ER54115	Oak Ridge National Lab., TN (United States)	
	18:7326	DOE/ER–0313/11
FG03-91ER81109	Lawrence Livermore National Lab., CA (United States)	
	18:6853	UCRL-JC–111508
FG03-91ER81228	Bend Research, Inc., OR (United States)	
	18:4849	DOE/ER/81228–93/C0100
FG03-91ER81229	Bend Research, Inc., OR (United States)	
	18:4849	DOE/ER/81228–93/C0100
FG03-92ER25117	Stanford Univ., CA (United States). Systems Optimization Lab.	
	18:7504	SOL–92-4
FG05-80ET53088	Texas Univ., Austin, TX (United States)	
	18:6835	DOE/ET–53088-577
	Texas Univ., Austin, TX (United States). Inst. for Fusion Studies	
	18:7164	DOE/ET/53088–578
	18:7165	DOE/ET–53088-583
	18:7379	DOE/ET/53088–576
FG05-86ER13507	Texas Univ., Austin, TX (United States). Dept. of Chemical Engineering	
	18:6092	DOE/ER/13507–8
FG05-86ER45266	Georgia Inst. of Tech., Atlanta, GA (United States). School of Physics	
	18:7128	DOE/ER/45266–T3
FG05-87ER13735	Texas Univ., Austin, TX (United States)	
	18:7372	DOE/ER/13735–T1
FG05-87ER40319	Florida State Univ., Tallahassee, FL (United States). Dept. of Physics	
	18:6855	DOE/ER/40319–T2
FG05-87ER40353	Tennessee Technological Univ., Cookeville, TN (United States). Dept. of Physics	
	18:6962	DOE/ER/40353–15
FG05-87ER40364	Virginia Univ., Charlottesville, VA (United States). Dept. of Physics	
	18:6926	DOE/ER/40364–T1
FG05-87ER40380	Southeastern Universities Research Association, Inc., Newport News, VA (United States). Continuous Electron Beam Accelerator Facility	
	18:6854	DOE/ER/40150–195
FG05-87ER51112	Georgia Inst. of Tech., Atlanta, GA (United States). Fusion Research Center	
	18:7171	GTFR–103
FG05-88ER13838	Maryland Univ., College Park, MD (United States). Dept. of Mechanical Engineering	
	18:6231	CONF-9205147–3
	Naval Research Lab., Washington, DC (United States)	
	18:6232	CONF-930155–1
FG05-88ER13848	Houston Univ., TX (United States). Dept. of Chemistry	
	18:6131	DOE/ER/13848–5
FG05-88ER13943	Virginia Univ., Charlottesville, VA (United States). Dept. of Chemical Engineering	
	18:7080	CONF-900971–5

Contract No.	Abstract No.	Report No.
FG05-88ER13954	Texas A and M Univ., College Station, TX (United States). Dept. of Chemistry	
	18:6133	DOE/ER/13954–4
FG05-88ER13958	Argonne National Lab., IL (United States). Physics Div.	
	18:7054	ANL/PHY/CP–77423
	18:7060	ANL/PHY/CP–77677
	Toledo Univ., OH (United States). Dept. of Physics and Astronomy	
	18:7056	DOE/ER/13958–30
FG05-88ER45359	Oak Ridge National Lab., TN (United States)	
	18:6003	CONF-8909210–
FG05-88ER45374	Tennessee Univ., Knoxville, TN (United States). Dept. of Chemistry	
	18:6136	DOE/ER/45374–1
FG05-88ER51115	Texas Univ., Austin, TX (United States). Center for Fusion Engineering	
	18:7374	DOE/ER/51115–T1
FG05-89ER60779	American Statistical Association, Alexandria, VA (United States)	
	18:6783	CONF-8907166–
FG05-90ER60971	Maryland Univ., College Park, MD (United States). Dept. of Meteorology	
	18:6472	DOE/ER/60971–3
FG05-90ER75585	Rice Univ., Houston, TX (United States)	
	18:6094	DOE/ER/75585–2
FG05-90ER80877	Advanced Fuel Research, Inc., East Hartford, CT (United States)	
	18:4846	DOE/ER/80877–93/C0116
FG05-90ER81057	Engineering Resources, Inc., Fayetteville, AR (United States)	
	18:5230	DOE/ER/81057–93/C0107
FG05-91ER12115	Texas Univ., Austin, TX (United States). Dept. of Mechanical Engineering	
	18:5859	CONF-9203140–4
FG05-91ER40617	Louisiana State Univ., Baton Rouge, LA (United States). Dept. of Physics and Astronomy	
	18:6863	DOE/ER/40617–129
FG05-91ER40621	Texas A and M Univ., College Station, TX (United States). Dept. of Physics	
	18:6952	DOE/ER/40621–2
FG05-91ER40627	Oak Ridge National Lab., TN (United States)	
	18:6439	CONF-920716–9
FG05-91ER40633	Texas A and M Univ., College Station, TX (United States). Dept. of Physics	
	18:6856	DOE/ER/40633–2
FG05-91ER54122	Georgia Inst. of Tech., Atlanta, GA (United States). Fusion Research Center	
	18:7170	GTFR–102
FG06-88ER40427	Los Alamos National Lab., NM (United States)	
	18:6904	LA-UR–92-3736
FG06-89ER75522	Oak Ridge National Lab., TN (United States)	
	18:7304	DOE/ER–0313/11
	18:7312	DOE/ER–0313/11
	18:7318	DOE/ER–0313/11
FG06-91ER45454	Washington State Univ., Pullman, WA (United States). Dept. of Mechanical and Materials Engineering	
	18:5940	DOE/ER/45454–T1
FG07-88ER12809	Michigan Univ., Ann Arbor, MI (United States). Dept. of Nuclear Engineering	
	18:5391	DOE/ER/12809–1
FG07-88ER12818	Virginia Univ., Charlottesville, VA (United States). Dept. of Mechanical, Aerospace and Nuclear Engineering	
	18:7043	DOE/ER/12818–2
FG07-88ER12824	Oak Ridge National Lab., TN (United States)	
	18:6202	CONF-9202142–1
	Tennessee Univ., Knoxville, TN (United States)	
	18:5466	CONF-9007253–1
	Tennessee Univ., Tullahoma, TN (United States). Space Inst.	
	18:6444	CONF-890374–4
	18:6445	CONF-8903223–1
	Tennessee Univ., Knoxville, TN (United States). Dept. of Nuclear Engineering	
	18:5448	CONF-910535–10
	18:5465	CONF-890634–5
	18:5467	CONF-9011312–1
	18:5469	CONF-9109110–10
	18:5470	DOE/ER/12824–1
	18:5492	CONF-900143–39
	18:5606	CONF-910535–6
	18:5607	CONF-9109110–14
	18:5608	CONF-9109110–15
	18:5609	CONF-9109110–16
	18:5610	CONF-9109447–2
	18:5611	CONF-920432–14
	18:6201	CONF-9109447–1
	18:7446	CONF-920368–1
	18:7447	CONF-920538–28
FG07-89DP48075	Waste Policy Inst., Blacksburg, VA (United States)	
	18:7510	DOE/DP/48075–3
FG21-87MC24138	Calderon Energy Co., Bowling Green, OH (United States)	
	18:4857	DOE/MC/24138–93/C0088
FG21-89MC26039	Lehigh Univ., Bethlehem, PA (United States). Zettlemoyer Center for Surface Studies	
	18:6138	DOE/MC/26039–3111
FG21-91MC28079	New England Research, Inc., White River Junction, VT (United States)	
	18:5010	DOE/MC/28079–3131
FG22-87PC79924	Case Western Reserve Univ., Cleveland, OH (United States). Dept. of Chemical Engineering	
	18:5362	DOE/PC/79924–T6
FG22-88PC88920	Idaho Univ., Moscow, ID (United States). Dept. of Metallurgical and Mining Engineering	
	18:4886	DOE/PC/88920–T24
FG22-89PC89768	Florida State Univ., Tallahassee, FL (United States). Dept. of Physics	
	18:5364	DOE/PC/89768–T7
	18:5365	DOE/PC/89768–T8
	18:5366	DOE/PC/89768–T9
	18:5367	DOE/PC/89768–T10
	18:5368	DOE/PC/89768–T11
	18:5369	DOE/PC/89768–T12
FG22-90PC90169	BCR National Lab., Pittsburgh, PA (United States)	
	18:4953	DOE/PC/90169–T7
FG22-90PC90290	Colorado State Univ., Fort Collins, CO (United States). Dept. of Chemistry	
	18:4901	DOE/PC/90290–8
	18:4902	DOE/PC/90290–9
FG22-90PC90295	Kentucky Univ., Lexington, KY (United States)	
	18:4839	DOE/PC/90295–T8
FG22-90PC90300	Stevens Inst. of Tech., Hoboken, NJ (United States). Dept. of Chemistry and Chemical Engineering	
	18:4888	DOE/PC/90300–T7

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FG22-91PC91280	**Alabama Univ., University, AL (United States). Mineral Resources Inst.**	
	18:4840	DOE/PC/91280–T5
FG22-91PC91287	**Georgia Inst. of Tech., Atlanta, GA (United States). School of Chemical Engineering**	
	18:4892	DOE/PC/91287–6
FG22-91PC91292	**Grambling State Univ., LA (United States). Dept. of Chemistry**	
	18:4956	DOE/PC/91292–T4
FG22-91PC91295	**Michigan Univ., Ann Arbor, MI (United States). Dept. of Chemical Engineering**	
	18:4905	DOE/PC/91295–T4
FG22-91PC91296	**New Mexico Univ., Albuquerque, NM (United States). Center for Micro-Engineered Ceramics**	
	18:4903	DOE/PC/91296–4
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77833	18:7034	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004153	MF-700
78013	18:6983	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004192	MF-413
ANL/ES/CP–					
77747	18:5722	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003045	MF-902
77925	18:5813	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004186	MF-310
ANL/FE/CP–					
75641	18:5916	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004241	MF-506
ANL/MCS-TM–					
163	18:7439	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004668	MF-405
ANL/MCT/CP–					
74743	18:5917	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003005	
76348	18:6230	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002905	MF-401
76404	18:5422	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002908	MF-532
76420	18:5423	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002907	MF-530
76909	18:7126	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004201	MF-310; MF-404
77573	18:6036	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002906	MF-114; MF-332
ANL/MCT/RP–					
77582	18:5908	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004228	MF-400; MF-500; MF-373
ANL/MCT/TMS–					
1	18:5453	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003191	
ANL/MSD/CP–					
75815	18:6037	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002909	MF-404
77538	18:5219	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002910	MF-404
77539	18:5918	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002911	MF-404
77605	18:6001	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002980	MF-404; MF-364

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ANL/MSD/CP–					
77606	18:6002	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002982	MF-404; MF-364
77607	18:6090	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002981	MF-404
77613	18:7440	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002979	MF-405
77654	18:5919	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002984	MF-404
77704	18:6038	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002983	MF-404
78010	18:5920	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004193	MF-404
78164	18:5921	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004861	MF-404
ANL/PHY/CP–					
76643	18:6315	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004199	MF-413
77109	18:7073	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002913	MF-411
77423	18:7054	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002914	MF-404
77536	18:6917	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002916	MF-413
77677	18:7060	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002912	MF-411
77681	18:6316	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002915	MF-413
77920	18:6990	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004197	MF-413
ANL/PHY/RP–					
77845	18:6991	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004039	MF-410
ANL/RA/CP–					
77740	18:5445	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002920	MF-500
ANL/RE/CP–					
75828	18:5922	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002917	MF-504
76730	18:6379	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002919	MF-900; MF-902
77809	18:5605	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002918	MF-532
ANL/RPG–					
93/1	18:6174	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004737	MF-401
ANL/TM–					
459-Rev.4	18:6317	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004821	MF-405
ANL/XFD/CP–					
76139	18:6442	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004178	MF-411
76595	18:6318	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004195	MF-404
77745	18:6319	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002921	MF-411
77991	18:6320	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004194	MF-411
AUC-IBT-R–					
9204	18:6196	OSTI; NTIS		DE93752802	
BCRNL-L–					
1665	18:4953	*See* DOE/PC/90169–T7			
BFR-D–					
8-92	18:5743	OSTI; NTIS; INIS		DE93753058	
BNL–					
34518-Ed.8	18:6275	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002937	MF-414
47339-App.	18:6667	*See* DOE/EH–0278T-App.			
47369	18:7127	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002325	MF-404
47623	18:6467	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002313	MF-402
47750	18:7085	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002950	MF-400
47763	18:5220	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002965	MF-404
47851	18:6321	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002328	MF-414
47861	18:6322	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002329	MF-414
47929	18:7441	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003143	MF-407
47979	18:6984	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003474	MF-404
48005	18:6380	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002951	MF-414
48012	18:6039	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002330	MF-410
48016	18:6641	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003473	MF-400
48026	18:5923	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003165	MF-404
48035	18:6992	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003167	MF-413
48044	18:6961	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003470	MF-413
48058	18:6123	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003141	MF-410
48062	18:6712	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002940	MF-408
48069	18:6890	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003170	MF-410
48081	18:6181	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002949	MF-401
48084	18:5924	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003142	MF-404
48087	18:6918	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002952	MF-414
48149	18:6333	*See* FNAL/C–92/310			
48171	18:6833	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003357	MF-401
52348	18:6292	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004633	PC-414
BNL-NUREG–					
52312	18:5639	*See* NUREG/CR–5816			
52339	18:5650	*See* NUREG/CR–5924			
BONN-IR–					
90-27	18:7055	OSTI; NTIS (US Sales Only); INIS		DE93742758	

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91-71	18:6993	OSTI; NTIS (US Sales Only); INIS		DE93742756	
92-06	18:6994	OSTI; NTIS (US Sales Only); INIS		DE93742757	
BROWN-HET–					
883	18:6886	*See* ANL-HEP-CP–92-90			
885	18:6916	*See* ANL-HEP-CP–92-117			
BS–					
290	18:5797	*See* LBL–32638			
BfS-ET–					
12/92	18:5117	OSTI; NTIS (US Sales Only); INIS		DE93742804	
BfS-ST–					
1/92	18:6553	OSTI; NTIS (US Sales Only); INIS		DE93742797	
CBPF-NF–					
030/91	18:6860	OSTI; NTIS (US Sales Only); INIS		DE93609914	
033/91	18:7077	OSTI; NTIS (US Sales Only); INIS		DE93610313	
034/91	18:7078	OSTI; NTIS (US Sales Only); INIS		DE93610314	
035/91	18:6861	OSTI; NTIS (US Sales Only); INIS		DE93609915	
CDTN-DERL-NT–					
001/89	18:7442	OSTI; NTIS (US Sales Only); INIS		DE93609810	
CDTN-DETQ–					
010/88	18:6091	OSTI; NTIS (US Sales Only); INIS		DE93608790	
CDTN-DETS-NI–					
005/89	18:6381	OSTI; NTIS (US Sales Only); INIS		DE93609499	
CDTN-NT–					
001/81	18:5491	OSTI; NTIS (US Sales Only); INIS		DE93609487	
CEBAF-PR–					
92-021	18:6925	*See* DOE/ER/40150–197			
CEES–					
93000363	18:6468	OSTI; INIS; Committee on Earth and Environmental Sciences, c/o National Science Foundation, Attn: Forms and Publications, 1800 G Street NW, Room 232, Washington, DC 20550		TI93000363	
CHEC–					
9103	18:4934	OSTI; NTIS		DE93752996	
9104	18:4935	OSTI; NTIS		DE93752993	
9105	18:4936	OSTI; NTIS		DE93752995	
9106	18:4937	OSTI; NTIS		DE93752994	
CONF-8808218–		(8. international conference on basement tectonics; Butte, MT (United States); 8-12 Aug 1988)			
	18:6794	*See* DOE/ER/14201–1			
CONF-8809281–		(4. topical meeting on short wavelength coherent radiation: generation and applications; North Falmouth, MA (United States); 26-29 Sep 1988)			
3	18:6443	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003496	MF-406
CONF-8811381–		(Workshop on medical physics; San Carlos de Bariloche (Argentina); 14-18 Nov 1988)			
	18:6645	*See* INIS-mf–13399			
CONF-8901144–		(Symposium on electrical power engineering at the Helsinki University of Technology; Espoo (Finland); 27 Jan 1989)			
	18:5748	*See* TKK-S/SM–1989/21			
CONF-8903223–		(2. sensor fusion conference; Orlando, FL (United States); 28-29 Mar 1989)			
1	18:6445	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002956	MF-405
CONF-890374–		(SPIE technical symposium on aerospace sensing; Orlando, FL (United States); 27-31 Mar 1989)			
4	18:6444	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002958	MF-405
CONF-890634–		(Expert systems applications for the electric power industry conference; Orlando, FL (United States); 5-8 Jun 1989)			
5	18:5465	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002120	MF-405
CONF-8907166–		(8. annual American Statistical Association conference on radiation and health: health effects of electric and magnetic fields: statistical support for research strategies; Cooper Mountain, CO (United States); 9-13 Jul 1989)			
	18:6783	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004099	MF-407

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CONF-8909464–		(12. Brazilian congress of applied computational mathematics; Sao Jose do Rio Preto (Brazil); 4-8 Sep 1989)			
	18:6644	*See* INIS-BR–3092			
CONF-8911255–		(3. workshop on combustion and propulsion; Lorena (Brazil); 28-30 Nov 1989)			
	18:7382	*See* INIS-BR–3091			
CONF-900143–		(Institute for Electronic and Electrical Engineers (IEEE) nuclear science symposium; San Francisco, CA (United States); 15-19 Jan 1990)			
39	18:5492	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002959	MF-405
CONF-9003335–		(Symposium on Technology in Laboratories; Toki (Japan); 19-20 Mar 1990)			
	18:7409	*See* NIFS-MEMO–3			
CONF-9004337–		(Interparliamentary conference on the global environment; Washington, DC (United States); 29 Apr - 2 may 1990)			
	18:6552	OSTI		TI93105289	
CONF-9007253–		(International Neural Network Society meeting; Paris (France); 9-13 Jul 1990)			
1	18:5466	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002126	MF-405
CONF-900971–		(12. European conference on thermophysical properties: ECTP-12; Vienna (Austria); 24-28 Sep 1990)			
5	18:7080	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003072	MF-411
CONF-9010289–		(International conference on high energy gamma ray astronomy; Ann Arbor, MI (United States); 2-5 Oct 1990)			
5	18:6834	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003720	MF-412
CONF-9010351–		(Conference on better air; Copenhagen (Denmark); 22-24 Oct 1990)			
	18:5707	*See* NEI-DK–989			
CONF-9011312–		(2. international conference on tools for artificial intelligence; Washington, DC (United States); 6-9 Nov 1990)			
1	18:5467	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002121	MF-405
CONF-910011–		(8. seminar on chemical control on metallurgy and the 4th meeting on carbochemistry; Rio de Janeior (Brazil); 1991)			
	18:6106	*See* INIS-BR–3096			
CONF-9101154–		(Symposium on incentives for using renewable energy sources in Bavaria; Coburg (Germany); 28-29 Jan 1991)			
	18:5751	OSTI; NTIS (US Sales Only)		DE93744689	
CONF-9102189–		(2. status seminar of Projektgruppe Bayern zur Erforschung der Wirkung von Umweltschadstoffen (PBWU) on forest decline; Neuherberg (Germany); 4-6 Feb 1991)			
	18:6741	*See* GSF–26/91			
CONF-9102193–		(5. Swieca School in Nuclear Physics; Campos do Jordao (Brazil); 19-28 Feb 1991)			
	18:6968	*See* INIS-BR–3112			
CONF-9103265–		(7. annual report of the Research Program for Air Pollution Prevention Measures of Kernforschungszentrum Karlsruhe GmbH; Karlsruhe (Germany); 5-7 Mar 1991)			
	18:6505	*See* KFK-PEF–80-Vol.2			
	18:6523	*See* KFK-PEF–81			
CONF-910406–		(Spring meeting of the Materials Research Society (MRS); Anaheim, CA (United States); 29 Apr - 3 may 1991)			
42	18:6039	*See* BNL–48012			
CONF-910414–		(International topical meeting on advances in mathematics, computation and reactor physics; Pittsburgh, PA (United States); 28 Apr - 2 may 1991)			
38	18:5446	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003462	MF-405
39	18:5447	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003463	MF-405

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CONF-9104287–		(1991 EPRI conference on power plant and power system training, simulators, and modeling; Miami, FL (United States); 17-19 Apr 1991)			
2	18:5468	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003196	MF-405
CONF-9104400–		(International symposium on ecological approaches of environmental chemicals; Debrecen (Hungary); 15-17 Apr 1991)			
	18:6723	*See* GSF–4/92			
CONF-9105304–		(Giornate di studio per la celebrazione del centenario della nascita di G. Ippolito; Naples (Italy); May 1991)			
2	18:5260	*See* ETDE-IT–92-100			
CONF-9105343–		(IAEA-Technical Committee meeting on materials for advanced water-cooled reactors; Plzen (Czechoslovakia); 14-17 May 1991)			
	18:5385	*See* IAEA-TECDOC–665			
CONF-910535–		(6. specialists meeting on reactor noise (SMORN); Gatlinburg, TN (United States); 19-24 May 1991)			
6	18:5606	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003543	MF-406; MF-405
10	18:5448	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003545	MF-405; MF-406
CONF-9105388–		(Hampton University Graduate Studies (HUGS) at the Continuous Electron Beam Accelerator Facility (CEBAF); Hampton, VA (United States); 29 May - 16 jun 1991)			
	18:6854	*See* DOE/ER/40150–195			
CONF-9105399–		(International conference on progress and applications of plasma focus research; Hoboken, NJ (United States); 27-31 May 1991)			
1	18:5226	*See* LA-UR–92-3506			
CONF-9106189–		(International conference on fossil plant cycle chemistry; Baltimore, MD (United States); 4-6 Jun 1991)			
2	18:5346	*See* ENEL-CRTN-T6–91-13			
CONF-9106401–		(NATO advanced study institute on dynamics modeling and flow in the earth and planets; Fairbanks, AK (United States); Jun 1991)			
1	18:6795	*See* LA-UR–92-2943			
CONF-9106417–		(ESM'91: European simulation multiconference; Copenhagen (Denmark); 17-19 Jun 1991)			
	18:5847	*See* DTH-IMSOR-RR–1991-2			
CONF-9107244–		(Illinois Fertilizer and Chemical Association's large tank clinic; Springfield, IL (United States); 17 Jul 1991)			
1	18:6224	*See* TVA-Bull–Z-307			
CONF-9107245–		(Controlled release fertilizer workshop - 1991; Sheffield, AL (United States); 30-31 Jul 1991)			
	18:6663	*See* TVA/NFERC–91/8			
CONF-910812–		(202. national meeting of the American Chemical Society (ACS); New York, NY (United States); 25-30 Aug 1991)			
16	18:5986	*See* TVA-Bull–Z-298			
18	18:5988	*See* TVA-Bull–Z-300			
19	18:5987	*See* TVA-Bull–Z-299			
CONF-9108179–		(13. Boundary element methods (BEM) conference; Tulsa, OK (United States); 21-23 Aug 1991)			
2	18:7477	*See* ETDE-IT–92-104			
CONF-9108228–		(2. research co-ordination meeting on co-ordinated research programme: Rapid instrumental and separation methods for monitoring radionuclides in food and environmental samples; Vienna (Austria); 12-16 Aug 1991)			
	18:6099	*See* IAEA-AL–056			

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CONF-9109110–		(International conference on frontiers in innovative computing for the nuclear industry; Jackson, WY (United States); 15-18 Sep 1991)			
10	18:5469	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003561	MF-405; MF-406
14	18:5607	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003557	MF-405; MF-406
15	18:5608	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003560	MF-405; MF-406
16	18:5609	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003559	MF-405; MF-406
CONF-9109409–		(6. national meeting on analytical chemistry; Araraquara (Brazil); 3-6 Sep 1991)			
	18:6105	*See* INIS-BR–3090			
CONF-9109446–		(1. Mexico-USA symposium on the frontiers in materials science; Ixtapa (Mexico); 24-27 Sep 1991)			
1	18:5907	*See* ANL/CP–72336			
CONF-9109447–		(2. government neural network applications workshop; Huntsville, AL (United States); 10-12 Sep 1991)			
1	18:6201	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003566	MF-405; MF-406
2	18:5610	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003567	MF-405
CONF-9109454–		(Symposium on Finnish-French symposium on water supply and sewerage; Helsinki (Finland); 25-27 Sep 1991)			
	18:5259	*See* VTT-SYMP–129			
CONF-9110134–		(10. Electric Power Research Institute (EPRI) coal gasification power plants conference; San Francisco, CA (United States); 16-17 Oct 1991)			
2	18:5829	*See* TVA-Bull–Z-297			
CONF-9110197–		(American Society for Engineering Management annual conference; 27. annual meeting of the Institute of Management Sciences; Chattanooga, TN (United States); Myrtle Beach, SC (United States); 20-22 Oct 1991; 3-4 oct 1991)			
3	18:7443	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93004151	MF-1000
4	18:7507	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93004149	MF-1000
CONF-9110404–		(IMA workshop on sparse matrix computations: graph theory issues and algorithms; Minneapolis, MN (United States); 14-18 Oct 1991)			
2	18:7444	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004119	MF-405
CONF-9110429–		(USA-USSR workshop on multiphase flow; Chicago, IL (United States); 2-4 Oct 1991)			
1	18:6233	*See* DOE/ER/13764–10			
CONF-9110444–		(American Society for Engineering Management annual conference; 27. annual meeting of the Institute of Management Sciences; Chattanooga, TN (United States); Myrtle Beach, SC (United States); 20-22 Oct 1991; 3-4 oct 1991)			
1	18:7443	*See* CONF-9110197–3			
CONF-9110445–		(Annual meeting of the fertilizer industry round table; Muscle Shoals, AL (United States); 21-25 Oct 1991)			
1	18:5830	*See* TVA-Bull–Z-304			
CONF-9110446–		(1. international workshop on the identification of transcribed swquences in the human genome; Bethesda, MD (United States); 4-5 Oct 1991)			
Absts.	18:6640	*See* DOE/ER/61245–1			
CONF-9110453–		(31. Brazilian Congress on Chemistry; Recife (Brazil); 21-25 Oct 1991)			
	18:6102	*See* INIS-BR–3076			

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	18:6103	*See* INIS-BR–3086			
CONF-911054–		(SPIE International Society for Optical Engineering meeting; Boulder, CO (United States); 23-25 Oct 1991)			
11	18:6271	*See* UCRL-JC–108124			
CONF-9111186–		(WASCON '91: international conference on environmental implications of construction with waste materials; Maastricht (Netherlands); 10-14 Nov 1991)			
1	18:6582	*See* NEI-DK–1007			
CONF-9111236–		(AGF meeting on ground pollution and water pollution: Stocktaking - carryover - redevelopment approaches; Bonn (Germany); 28-29 Nov 1991)			
	18:6554	OSTI; NTIS (US Sales Only)		DE93742729	
CONF-9111277–		(Information meeting 'Disposal of radioactive wastes'; Berlin (Germany); 25-26 Nov 1991)			
	18:5117	*See* BfS-ET–12/92			
CONF-9111280–		(1. Brazilian Congress on Polymers; Sao Paulo (Brazil); 5-7 Nov 1991)			
	18:5222	*See* INIS-BR–3103			
	18:5223	*See* INIS-BR–3104			
	18:5224	*See* INIS-BR–3108			
	18:6175	*See* INIS-BR–3105			
	18:6176	*See* INIS-BR–3106			
	18:6177	*See* INIS-BR–3107			
	18:6178	*See* INIS-BR–3109			
	18:6179	*See* INIS-BR–3111			
CONF-9111281–		(2. Scandinavian forum for stochastic mechanics; Aalborg (Denmark); 21-22 Nov 1991)			
	18:6196	*See* AUC-IBT-R–9204			
CONF-9111283–		(23. IEA-AFBC-meeting; Firenze (Italy); 8 Nov 1991)			
1	18:4934	*See* CHEC–9103			
1	18:4935	*See* CHEC–9104			
CONF-911143–		(5. international offshore Northern Seas advanced petroleum conference: exploration and development strategies in mature areas; Stavanger (Norway); 19-20 Nov 1991)			
	18:4969	*See* NEI-NO–293			
CONF-9112111–		(KEK workshop on rare kaon decay physics; Tsukuba (Japan); 10-11 Dec 1991)			
2	18:6918	*See* BNL–48087			
CONF-9112112–		(Current status, research needs, and opportunities in applications of surface processing applications to transportation and utilities technologies; Washington, DC (United States); 10-12 Dec 1991)			
	18:5910	*See* NREL/CP–412-5007			
CONF-9112143–		(Alimentazione elettrica delle grandi aree urbane; Milan (Italy); 10-11 Dec 1991)			
3	18:5667	*See* ETDE-IT–92-101			
CONF-9112148–		(Workshop on 'light particle-induced reactions'; Osaka (Japan); 5-7 Dec 1991)			
	18:7026	*See* RCNP-P–120			
CONF-9201120–		(Royal Society discussion meeting on time resolved macromolecular crystallography; London (United Kingdom); 29-30 Jan 1992)			
1	18:6123	*See* BNL–48058			
CONF-9201121–		(Institutional aspects of international cooperation on climate change; Bellagio (Italy); 28-30 Jan 1992)			
Summ.	18:6473	*See* DOE/ER/61010–2			
CONF-9201125–		(Symposium on 'radiation research in life science'; Kumatori (Japan); 16-17 Jan 1992)			
	18:6693	*See* KURRI-TR–363			
CONF-9202117–		(Physics of isolated pulsars workshop; Taos, NM (United States); 23-28 Feb 1992)			
6	18:6851	*See* UCRL-JC–111252			
8	18:6852	*See* UCRL-JC–111254			
7-Rev.1	18:6849	*See* UCRL-JC–105642-Rev.1			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-9202140–		(6. European symposium on semiconductor detectors: new developments on radiation detectors; Milan (Italy); 24-26 Feb 1992)			
1	18:6380	*See* BNL–48005			
CONF-9202142–		(WNN-92: workshop on neural networks; Alburn, AL (United States); 10-12 Feb 1992)			
1	18:6202	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003554	MF-405; MF-406
CONF-9202145–		(Workshop on computation and analysis of nuclear data relevant to nuclear energy and safety; Miramare (Italy); 10 Feb - 13 mar 1992)			
	18:5451	*See* KFK–5073			
CONF-9202146–		(Workshop on new aspects of quantum field theories; Tanashi (Japan); 17-19 Feb 1992)			
	18:6876	*See* INS-T–513			
CONF-9202147–		(3. workshop on light quark meson spectroscopy; Tsukuba (Japan); 28-29 Feb 1992)			
	18:6421	*See* KEK-PROC–92-8			
CONF-920305–		(Minerals, Metals, and Materials Society (TMS) annual meeting and exhibition; San Diego, CA (United States); 1-5 Mar 1992)			
	18:5220	*See* BNL–47763			
CONF-920312–		(International IFAC symposium on control of power plants and power systems; Munich (Germany); 9-11 Mar 1992)			
1	18:5848	*See* DTH-IMSOR-RR–1991-21			
CONF-9203138–		(Engineering Foundation conference on dispersion and aggregation; Palm Coast, FL (United States); 15-20 Mar 1992)			
2	18:6004	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003018	MF-332
CONF-9203140–		(1992 Spring meeting of the Western States Section of the Combustion Institute; Corvallis, OR (United States); 23-24 Mar 1992)			
4	18:5859	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003101	MF-406
CONF-9203194–		(Tank waste science panel meeting; Denver, CO (United States); 25-27 Mar 1992)			
Summ.	18:5170	*See* PNL–8278			
CONF-9203207–		(American Society for Engineering Management annual conference; 14. conference on computers and industrial engineering; Chattanooga, TN (United States); Cocoa Beach, FL (United States); 20-22 Oct 1991; 9-11 mar 1992)			
1	18:7507	*See* CONF-9110197–4			
CONF-9203213–		(2. technical meeting on High Temperature Gas-cooled Reactors; Tokai (Japan); 11-12 Mar 1992)			
	18:5419	*See* JAERI-M–92-090			
CONF-920331–		(International industrial symposium on the super collider; New Orleans, LA (United States); 4-6 Mar 1992)			
60	18:6322	*See* BNL–47861			
CONF-920368–		(2. international forum on expert systems and computer simulation in energy engineering; Erlangen (Germany); 17-21 Mar 1992)			
1	18:7446	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003541	MF-405; MF-406
CONF-920383–		(Western regional meeting of the Society of Petroleum Engineers (SPE); Bakersfield, CA (United States); 30 Mar - 1 apr 1992)			
3	18:4977	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002456	MF-250
CONF-920402–		(1992 Material Research Society (MRS) spring meeting; San Francisco, CA (United States); 27 Apr - 2 may 1992)			
61	18:6025	*See* LBL–32828			
63	18:6065	*See* SAND–91-2891C			
64	18:6066	*See* SAND–91-2892C			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-9204126–		(B factories: state of the art in accelerators, detectors, and physics; Stanford, CA (United States); 6-10 Apr 1992)			
	18:6368	*See* DESY–92-121			
15	18:6356	*See* SLAC-PUB–5932			
16	18:6432	*See* SLAC-PUB–5925			
18	18:6352	*See* LBL–32981			
CONF-9204138–		(International conference of radiation-tolerant scintillators and detectors; Tallahassee, FL (United States); 28 Apr - 2 may 1992)			
8	18:6172	*See* ANL/CHM/CP–75982			
CONF-9204186–		(Future direction in electron-ion collision physics; Atlanta, GA (United States); 9-10 Apr 1992)			
1	18:7063	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004531	MF-411
2	18:6798	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004532	MF-411
CONF-9204213–		(1. international conference on ground water ecology; Tampa, FL (United States); 26 Apr 1992)			
1	18:6612	*See* DOE/ER/61192–1			
CONF-9204214–		(Thermodynamics of alloys 1992; Nancy (France); 28 Apr - 1 may 1992)			
1	18:5974	*See* LBL–32827			
CONF-9204217–		(12. Institute of Electrical and Electronic Engineers (IEEE) symposium on mass storage systems; Monterey, CA (United States); 25-29 Apr 1992)			
1	18:7493	*See* LA-UR–92-3600			
CONF-920432–		(54. annual American power conference; Chicago, IL (United States); 13-15 Apr 1992)			
14	18:5611	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003552	MF-405; MF-406
CONF-920458–		(Corrosion '92 conference and exhibition; Nashville, TN (United States); 27 Apr - 1 may 1992)			
11	18:5177	*See* WSRC-MS–91-511			
CONF-920472–		(Copper Mountain conference on iterative methods; Copper Mountain, CO (United States); 9-16 Apr 1992)			
Vol.1	18:7452	*See* DOE/ER/25106–1-Vol.1			
Vol.2	18:7453	*See* DOE/ER/25106–1-Vol.2			
CONF-920480–		(International conference on liquid radiation detectors (ICLRD): their fundamental properties and applications; Tokyo (Japan); 7-10 Apr 1992)			
2	18:6383	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003034	MF-412
CONF-9205147–		(10. symposium on energy engineering sciences: synergism of analysis, modeling, and experiment; Argonne, IL (United States); 11-13 May 1992)			
3	18:6231	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004122	MF-406
CONF-9205198–		(Organization for economic cooperation and development, Nuclear Energy Agency Nuclear Science Committee (NEANSC) specialists' meeting on fission product nuclear data; Tokai-mura (Japan); 25-27 May 1992)			
4	18:5159	*See* LA-UR–92-3761			
5	18:7018	*See* LA-UR–92-3762			
CONF-9205201–		(Solar-terrestrial predictions workshop; Ottawa (Canada); 18-22 May 1992)			
2	18:6841	*See* LA-UR–92-3315			
CONF-9205229–		(Center for Nonlinear Studies (CNLS) conference: nonlinearity in materials science; Los Alamos, NM (United States); May 1992)			
2	18:5909	*See* LA-UR–92-3783			
CONF-9205269–		(Realistic nuclear structure; Stony Brook, NY (United States); 28-30 May 1992)			
1	18:6891	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002424	MF-414
CONF-9205272–		(11. annual conference on properties and applications of magnetic materials; Chicago, IL (United States); 12-14 May 1992)			
1	18:6321	*See* BNL–47851			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-9205273–		(91. annual conference of the Deutsche Bunsen-Gesellschaft fuer Physikalische Chemie; Vienna (Austria); 28-30 May 1992)			
1	18:7082	*See* LBL–32832			
CONF-9205274–		(Trieste workshop on the search for new elementary particles: particles, status and prospects; Trieste (Italy); 20-22 May 1992)			
1	18:6290	*See* SSCL-Preprint–158			
2	18:6958	*See* SLAC-PUB–5958			
CONF-9205279–		(2. national symposium on thermal solar energy (TSE); Staffelstein (Germany); 14-15 May 1992)			
	18:5775	OSTI; NTIS (US Sales Only)		DE93744460	
CONF-920536–		(8. power plant dynamics, control and testing symposium; Knoxville, TN (United States); 27-29 May 1992)			
28	18:7447	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003549	MF-405; MF-406
CONF-9206131–		(3. international symposium on the history of particle physics - the rise of the standard model; Stanford, CA (United States); 24-27 Jun 1992)			
3	18:6957	*See* SLAC-PUB–5937			
CONF-9206173–		(3. international conference on trends in welding research; Gatlinburg, TN (United States); 1-5 Jun 1992)			
10	18:5929	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003012	MF-404; MF-406
CONF-9206182–		(Department of Energy (DOE) records management conference; Denver, CO (United States); 23-25 Jun 1992)			
	18:7418	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002696	MF-900
CONF-9206193–		(Advanced accelerator concepts workshop; Port Jefferson, NY (United States); 14-20 Jun 1992)			
18	18:6323	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003495	MF-414
CONF-9206202–		(NATO advanced study institute on statics and dynamics of alloy phase transformations; Rhodes (Greece); 21 Jun - 3 jul 1992)			
5	18:5975	*See* LBL–32831			
CONF-9206222–		(International conference on advanced technology and particle physics; Como (Italy); 22-26 Jun 1992)			
4	18:6390	*See* FNAL/C–92/273			
5	18:6392	*See* FNAL/C–92/275			
6	18:6393	*See* FNAL/C–92/276			
CONF-9206227–		(15. international conference on neutrino physics; Granada (Spain); 7-13 Jun 1992)			
4	18:6955	*See* LA-UR–92-3956			
5	18:6939	*See* LA-UR–92-3614			
6	18:6953	*See* FNAL/C–92/297-E			
CONF-9206235–		(International Atomic Energy Agency (IAEA) technical committee meeting on advances in simulation and modeling of thermonuclear plasmas; Montreal (Canada); 15 Jun 1992)			
3	18:7167	*See* GA-A–20978			
4	18:7245	*See* UCRL-JC–109895			
CONF-9206240–		(2. Long Duration Exposure Facility (LDEF) post-retrieval symposium; San Diego, CA (United States); 1-5 Jun 1992)			
2	18:6112	*See* LBL–32920			
CONF-9206251–		(Physics beyond the standard model III conference; Ottawa (Canada); 22-24 Jun 1992)			
3	18:6890	*See* BNL–48069			
CONF-9206273–		(2. international conference on bioinformatics, supercomputing, and complex genome analysis; St. Petersburg, FL (United States); 4-7 Jun 1992)			
2	18:6637	*See* ANL/BIM/CP–75997			

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CONF-9206280--		(Workshop on QCD vacuum structure; Paris (France); 1-5 Jun 1992)			
3	18:6863	*See* DOE/ER/40617--129			
CONF-9206282--		(16. ASTM international symposium on the effects of radiation on materials(ISERM); Aurora, CO (United States); 23-25 Jun 1992)			
2	18:5917	*See* ANL/MCT/CP--74743			
CONF-9206284--		(7. international symposium on very high energy cosmic ray interactions; Ann Arbor, MI (United States); 21-27 Jun 1992)			
2	18:6886	*See* ANL-HEP-CP--92-90			
CONF-9206302--		(Workshop on quantum chromodynamics (QCD) - 20 years later; Aachen (Germany); 9-13 Jun 1992)			
	18:6924	*See* DESY--92-122			
CONF-9206310--		(Superconducting Super Collider Laborabory (SSCL) rf workshop; Argonne, IL (United States); 25-26 Jun 1992)			
1	18:6324	*See* FNAL/C--92/227			
CONF-9206312--		(1992 European Biophysical Society (EBSA) workshop on water on water-biomolecule interactions; Palermo (Italy); Jun 1992)			
1	18:6150	*See* LA-UR--92-3260			
CONF-9206313--		(AIAA computational fluid dynamics conference; Orlando, FL (United States); 21-23 Jun 1992)			
1	18:7488	*See* LA-UR--92-3363			
CONF-9206314--		(TASI summer school; Boulder, CO (United States); 11-29 Jun 1992)			
1	18:6878	*See* LA-UR--92-3479			
CONF-9206317--		(7. international conference on graph theory, combinatorics, algorithms, and applications; Kalamazoo, MI (United States); 1-5 Jun 1992)			
1	18:7494	*See* LA-UR--92-3725			
CONF-9206318--		(NASA conference; Houston, TX (United States); 1-3 Jun 1992)			
1	18:7492	*See* LA-UR--92-3568			
CONF-9206319--		(37. annual symposium of the American Scientific Glassblowers Society (ASGS); Dearborn, MI (United States); 21-26 Jun 1992)			
1	18:6031	*See* ANL/CHM/CP--76424			
CONF-9206322--		(4. topical seminar on the standard model and just beyond; San Miniato (Italy); 1-5 Jun 1992)			
1	18:6391	*See* FNAL/C--92/274			
CONF-920637--		(International conference on the structure of baryons and related mesons; New Haven, CT (United States); 1-4 Jun 1992)			
7	18:6925	*See* DOE/ER/40150--197			
CONF-920664--		(7. international conference on boundary element technology; Albuquerque, NM (United States); 3-5 Jun 1992)			
3	18:6847	*See* SAND--91-2396C			
CONF-920670--		(6. international conference on intergranular and interphase boundaries in materials; Thessaloniki (Greece); 22-26 Jun 1992)			
6	18:6000	*See* ANL/CP--77534			
CONF-920672--		(24. national American Society for Testing and Materials symposium on fracture mechanics; Gatlinburg, TN (United States); 30 Jun - 2 jul 1992)			
3	18:5928	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003088	
CONF-920682--		(International symposium on weak and electromagnetic interactions in nuclei; Dubna (Russian Federation); 16-22 Jun 1992)			
2	18:6942	*See* LA-UR--92-3807			
CONF-920706--		(International conference on high energy accelerators; Hamburg (Germany); 20-24 Jul 1992)			
45	18:6294	*See* FNAL/C--92/187			
46	18:6373	*See* LBL--32559			

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CONF-9207102–		(Institute of Nuclear Materials Management (INMM) annual meeting; Orlando, FL (United States); 19-22 Jul 1992)			
71	18:5207	*See* WHC-SA–1446			
CONF-9207140–		(Stanford Linear Accelerator Center (SLAC) summer institute on particle accelerators: third family and the physics of flavor; Stanford, CA (United States); 13-24 Jul 1992)			
2	18:6959	*See* SLAC-PUB–6002			
CONF-9207155–		(Quantitative nondestructive evaluation conference; San Diego, CA (United States); 19-24 Jul 1992)			
2	18:6033	*See* ANL/CP–75819			
CONF-920716–		(Nuclear and space radiation effects conference; New Orleans, LA (United States); 13-17 Jul 1992)			
9	18:6439	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003104	MF-413
CONF-9207162–		(Broadband analog and digital opto-electronics; Santa Barbara, CA (United States); 29-31 Jul 1992)			
1	18:6364	*See* UCRL-JC–110847			
CONF-9207163–		(Southern California air quality study data analysis conference; Los Angeles, CA (United States); 21-23 Jul 1992)			
1	18:6467	*See* BNL–47623			
CONF-9207166–		(1992 Studies of the earth's deep interior (SEDI) symposium; Mizusawa (Japan); 5-10 Jul 1992)			
1	18:6845	*See* LA-UR–92-3819			
CONF-9207167–		(Entropy and Bayesian workshop; Paris (France); Jul 1992)			
1	18:7489	*See* LA-UR–92-3387			
CONF-9207168–		(Geospace environment modeling workshop on magnetotail/substorms; Snowmass, CO (United States); 2-3 Jul 1992)			
1	18:6846	*See* LA-UR–92-3845			
CONF-9207169–		(22. international symposium on multiparticle dynamics; Santiago de Compostela (Spain); 13-17 Jul 1992)			
1	18:6892	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004166	MF-414
CONF-920721–		(6. international conference on nuclei far from stability and 9th international conference on atomic masses and fundamental constants; Bernkastel-Kues (Germany); 19-24 Jul 1992)			
14	18:6971	*See* LBL–32818			
CONF-920741–		(13 international conference on cyclotrons and their applications; Vancouver (Canada); 6-16 Jul 1992)			
6	18:6289	*See* LBL–32963			
CONF-920762–		(International conference on the physics of transition metals; Darmstadt (Germany); 20-24 Jul 1992)			
8	18:5930	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003584	MF-411
CONF-920768–		(Conference on physics and engineering of advanced detectors and collection/focusing systems; San Diego, CA (United States); 19-24 Jul 1992)			
7	18:6318	*See* ANL/XFD/CP–76595			
8	18:6442	*See* ANL/XFD/CP–76139			
CONF-920777–		(NATO advanced study institute on particle production in highly excited matter; Ciocco (Italy); 12-25 Jul 1992)			
2	18:6919	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003083	MF-414
3	18:7015	*See* LA-UR–92-3241			
CONF-920792–		(Society of Photo-Optical Instrumentation Engineers (SPIE) international symposium on optical applied science and engineering; San Diego, CA (United States); 19-24 Jul 1992)			
40	18:6313	*See* ANL/CP–77509			
41	18:6319	*See* ANL/XFD/CP–77745			
42	18:6853	*See* UCRL-JC–111508			

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43	18:5969	*See* LA-UR--92-3490			
44	18:6320	*See* ANL/XFD/CP--77991			
45	18:6353	*See* LBL--33068			
CONF-920799--		(Review of progress in quantitative non destructive evaluation (NDE); La Jolla, CA (United States); 19-24 Jul 1992)			
3	18:4943	*See* DOE/METC/C--93/7039			
CONF-920802--		(Applied superconductivity conference; Chicago, IL (United States); 23-28 Aug 1992)			
	18:6362	*See* SSCL-Preprint--147			
26	18:6344	*See* LBL--32072			
28	18:7127	*See* BNL--47369			
29	18:6001	*See* ANL/MSD/CP--77605			
30	18:5999	*See* ANL/CP--77533			
31	18:7125	*See* ANL/CP--77532			
32	18:6441	*See* LBL--32152			
34	18:6348	*See* LBL--32788			
35	18:6343	*See* LBL--32071			
36	18:5998	*See* ANL/CP--77481			
37	18:6347	*See* LBL--32635			
38	18:6325	*See* FNAL/C--92/257			
40	18:6329	*See* FNAL/C--92/291			
43	18:6351	*See* LBL--32978			
44	18:7144	*See* LBL--32979			
45	18:7143	*See* LBL--32891			
CONF-9208109--		(16. international LINAC conference; Ottawa (Canada); 23-28 Aug 1992)			
66	18:6354	*See* SLAC-PUB--5888			
67	18:6274	*See* ANL/CP--76391			
69	18:6286	*See* LBL--32182			
70	18:6345	*See* LBL--32178			
CONF-9208129--		(Annual Denver x-ray conference; Denver, CO (United States); 3-7 Aug 1992)			
5	18:6090	*See* ANL/MSD/CP--77607			
6	18:6115	*See* SAND--92-2079C			
7	18:6005	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003105	MF-332
8	18:6027	*See* SAND--92-0914C			
9	18:5931	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003031	MF-332
CONF-920813--		(Joint Varenna-Lausanne international workshop on theory of fusion plasmas; Varenna (Italy); 24-28 Aug 1992)			
2	18:7164	*See* DOE/ET/53088--578			
CONF-9208132--		(1992 international conference on science and technology of synthetic metals (ICSM); Goeteborg (Sweden); 12-18 Aug 1992)			
3	18:7123	*See* LA-UR--92-3237			
4	18:6056	*See* LA-UR--92-3238			
6	18:7093	*See* LA-UR--92-3236			
CONF-9208142--		(14. international free electron laser conference; Kobe (Japan); 23-28 Aug 1992)			
8	18:6301	*See* LBL--32221			
9	18:6346	*See* LBL--32232			
10	18:6287	*See* LBL--32220			
11	18:6306	*See* ANL/ASD/CP--76106			
12	18:6288	*See* LBL--32223			
14	18:6283	*See* LA-UR--92-3441			
15	18:6266	*See* LA-UR--92-3231			
16	18:6302	*See* LBL--32286			
CONF-9208144--		(5. international conference on the science and technology of zirconia; Melbourne (Australia); 16-21 Aug 1992)			
3	18:5769	*See* DOE/MC/28055--93/C0135			
CONF-920815--		(204. American Chemical Society (ACS) national meeting; Washington, DC (United States); 23-28 Aug 1992)			
13	18:6073	*See* TVA-Bull--Z-319			
17	18:6072	*See* TVA-Bull--Z-317			
CONF-9208151--		(Gordon conference on photonuclear reactions; Tilton, NH (United States); 10 Aug 1992)			
	18:7029	*See* UM-P--92/56			

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CONF-9208155--		(9. international congress on photosynthesis; Nagoya (Japan); 30 Aug - 5 sep 1992)			
3	18:6712	*See* BNL--48062			
CONF-9208160--		(7. international conference on x-ray absorption fine structure; Kobe (Japan); 23-29 Aug 1992)			
5	18:5924	*See* BNL--48084			
CONF-9208174--		(7. conference on stability and the offense/defense relationship; Monterey, CA (United States); 26-27 Aug 1992)			
Vol.1	18:5903	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002033	MF-900
Vol.2	18:5904	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002034	MF-900
CONF-9208175--		(2. workshop on role of point defects/defect complexes in silicon device fabrication; Breckenridge, CO (United States); 24-26 Aug 1992)			
1	18:5275	*See* SAND--92-1825C			
Absts.	18:5272	*See* NREL/CP--413-5064			
CONF-9208176--		(10. symposium on computational statistics; Neuchatel (Switzerland); 23-28 Aug 1992)			
1	18:7448	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002826	MF-405
CONF-9208177--		(8. international conference on liquid and amorphous metals; Wien (Austria); 31 Aug - 4 sep 1992)			
1	18:6037	*See* ANL/MSD/CP--75815			
CONF-9208179--		(7. international congress of mucosal immunology; Prague (Czechoslovakia); 16-20 Aug 1992)			
1	18:6632	*See* ANL/BIM/CP--76001			
CONF-9208181--		(GOND 1992: seismic investigation of the sun and stars; Boulder, CO (United States); 11-14 Aug 1992)			
1	18:6850	*See* UCRL-JC--110144			
CONF-9208182--		(Symposium on the foundations of modern physics 1992: the philosophic thought of Wolfgang Pauli; Helsinki (Finland); 10-12 Aug 1992)			
1	18:6797	*See* LBL--32761			
CONF-9208183--		(8. international symposium on applications of ferroelectrics; Spokane, WA (United States); 31 Aug - 2 sep 1992)			
1	18:6068	*See* SAND--92-2177C			
CONF-9208184--		(Anomalous scattering international conference; Malente (Germany); 17-21 Aug 1992)			
1	18:5970	*See* LA-UR--92-3491			
CONF-9208187--		(Solar and Heliospheric Observatory (SOHO) workshop; Annapolis, MD (United States); 25-28 Aug 1992)			
1	18:6842	*See* LA-UR--92-3336			
CONF-9208189--		(International symposium on quantum physics in the universe; Tokyo (Japan); 19-23 Aug 1992)			
1	18:7487	*See* LA-UR--92-3339			
CONF-9208190--		(27. Zakopane School of Physics conference; Zakopane (Poland); 31 Aug - 3 sep 1992)			
1	18:6990	*See* ANL/PHY/CP--77920			
CONF-9208192--		(Nordic seminar on combustion and gasification reactivities of solid fuels; Roskilde (Denmark); 19-20 Aug 1992)			
	18:4958	*See* NEI-DK--981			
CONF-920825--		(21. international conference on the physics of semiconductors; Beijing (China); 10-14 Aug 1992)			
2	18:6061	*See* LBL--32833			
CONF-920828--		(American Council for an Energy-Efficient Economy (ACEEE) summer study on energy efficiency in buildings; Pacific Grove, CA (United States); 30 Aug - 5 sep 1992)			
21	18:5797	*See* LBL--32638			
22	18:5744	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003092	MF-350
23	18:7419	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003606	MF-222

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-920829--		(5. international workshop on slow-positron beam techniques for solids and surfaces; Jackson, WY (United States); 6-10 Aug 1992)			
1	18:6984	*See* BNL--47979			
CONF-920837--		(ICHEP-26: 26th International Union of Pure and Applied Physics (IUPAP) conference on high energy physics; Dallas, TX (United States); 6-12 Aug 1992)			
8	18:6915	*See* ANL-HEP-CP--92-85			
9	18:6914	*See* ANL-HEP-CP--92-79			
10	18:6897	*See* FNAL/C--92/253-E			
11	18:6434	*See* SLAC-PUB--5946			
12	18:6433	*See* SLAC-PUB--5945			
13	18:6374	*See* SLAC-PUB--5936			
14	18:6945	*See* SLAC-PUB--5926			
15	18:6917	*See* ANL/PHY/CP--77536			
17	18:6947	*See* SLAC-PUB--5973			
18	18:6303	*See* SSCL-Preprint--161			
22	18:6938	*See* LA-UR--92-3489			
23	18:6940	*See* LA-UR--92-3719			
24	18:6276	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003033	MF-414
25	18:6928	*See* FNAL/C--92/262			
26	18:6396	*See* FNAL/C--92/306			
27	18:6395	*See* FNAL/C--92/305			
28	18:6332	*See* FNAL/C--92/304			
29	18:6397	*See* FNAL/C--92/307			
30	18:6956	*See* LBL--32953			
32	18:6930	*See* FNAL/C--92/302			
33	18:6389	*See* FNAL/C--92/263-E			
34	18:6905	*See* LBL--32938			
35	18:6929	*See* FNAL/C--92/287-E			
36	18:6927	*See* FNAL/C--92/252-E			
CONF-920843--		(3. Institute of Electrical and Electronic Engineers (IEEE) workshop on computers in power electronics; Berkeley, CA (United States); 9-11 Aug 1992)			
2	18:6340	*See* LA-UR--92-3494			
CONF-920851--		(Spectrum '92: nuclear and hazardous waste management international topical meeting; Boise, ID (United States); 23-27 Aug 1992)			
81	18:5199	*See* PNL-SA--20868			
84-Rev.1	18:6596	*See* WSRC-MS--92-175-Rev.1			
CONF-920852--		(11. international congress of rheology; Brussels (Belgium); 17-21 Aug 1992)			
5	18:7083	*See* SAND--91-2174C			
CONF-920893--		(Joint statistical meetings of the American Statistical Association, the Biometric Society and the Institute of Mathematical Statistics; Boston, MA (United States); 9-13 Aug 1992)			
6	18:6577	*See* LA-UR--92-3371			
CONF-920909--		(8. international meeting on radiation processing; Beijing (China); 14-19 Sep 1992)			
1	18:6173	*See* ANL/CP--76176			
CONF-920913--		(14. international conference on plasma physics and controlled nuclear fusion research; Wuerzburg (Germany); 30 Sep - 7 oct 1992)			
3	18:7150	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001705	MF-426
19	18:7151	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002361	MF-413
20	18:7380	*See* GA-A--21044			
21	18:7168	*See* GA-A--21053			
22	18:7169	*See* GA-A--21055			
23	18:7381	*See* GA-A--21045			
24	18:7152	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004160	MF-427
CONF-9209141--		(19. annual American Society for Quality Control (ASQC) National Energy Division conference; Orlando, FL (United States); 20-23 Sep 1992)			
3	18:7432	*See* UCRL-JC--111311			
4	18:7429	*See* PNL-SA--21253			

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CONF-920916–		(3. international conference and exhibition of the World Congress on Superconductivity; Munich (Germany); 14-19 Sep 1992)			
3	18:6017	*See* IS-M–729			
CONF-9209160–		(International symposium on energy, environment and information management; Argonne, IL (United States); 15-18 Sep 1992)			
21	18:6466	*See* ANL/CP–77427			
22	18:4933	*See* ANL/CP–77469			
CONF-9209172–		(5. nuclear reactor thermal-hydraulics (NURETH) conference; Salt Lake City, UT (United States); 21-24 Sep 1992)			
3	18:5452	*See* WSRC-MS–92-028			
CONF-9209188–		(20. international congress on high speed photography and photonics; Victoria (Canada); 25-26 Sep 1992)			
6	18:6451	*See* UCRL-JC–108962			
CONF-9209201–		(Application of fluidized-bed combustion for power generation utility conference; Boston, MA (United States); 23-25 Sep 1992)			
3	18:4942	*See* DOE/MC/27364–93/C0078			
CONF-9209202–		(International conference on strongly correlated electron systems; Sendai (Japan); 7-11 Sep 1992)			
3	18:6038	*See* ANL/MSD/CP–77704			
CONF-9209204–		(Cray users group meeting; Washington, DC (United States); 14-18 Sep 1992)			
4	18:7491	*See* LA-UR–92-3499			
CONF-9209205–		(Symposium of northeastern accelerator personnel (SNEAP); Quebec (Canada); 23-25 Sep 1992)			
3	18:6316	*See* ANL/PHY/CP–77681			
4	18:6277	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003609	MF-413
CONF-920921–		(6. international symposium on small particles and inorganic clusters; Chicago, IL (United States); 16-22 Sep 1992)			
5	18:5913	*See* ANL/CHM/CP–77746			
6	18:6180	*See* ANL/CHM/CP–77717			
7	18:7053	*See* IS-M–721			
CONF-9209225–		(International seminar on structural investigation at pulsed neutron sources; Dubna (Russian Federation); 1-4 Sep 1992)			
2	18:7094	*See* LA-UR–92-3271			
CONF-9209229–		(Industrial and engineering chemistry (I&EC) special symposium of the American Chemical Society (ACS); Atlanta, GA (United States); 21-23 Sep 1992)			
2	18:5202	*See* SAND–92-0817C			
CONF-9209239–		(Workshop on nuclear physics in the universe; Oak Ridge, TN (United States); 24-26 Sep 1992)			
2	18:6961	*See* BNL–48044			
CONF-9209240–		(Society of Engineering Science (SES) technical meeting; San Diego, CA (United States); 14-16 Sep 1992)			
2	18:5981	*See* SAND–92-0921C			
3	18:5973	*See* LBL–32810			
CONF-9209243–		(Advisory group meeting on nuclear data requirements for fission reactor decommissioning; Vienna (Austria); 7-11 Sep 1992)			
1	18:5652	*See* PNL-SA–21322			
CONF-9209244–		(Tobacco chemists' research conference; Montreal (Canada); 27-30 Sep 1992)			
1	18:5790	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001376	
CONF-9209252–		(Photovoltaics performance and reliability workshop; Golden, CO (United States); 16-18 Sep 1992)			
1	18:5273	*See* NREL/TP–411-5125			

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CONF-9209253–		(Crystal 2000 international workshop on heavy scintillators for scientific and industrial applications; Chamonix (France); 22-26 Sep 1992)			
1	18:6082	*See* UCRL-JC–112124			
CONF-9209255–		(1. international E. Coli Genome meeting; Madison, WI (United States); 10-14 Sep 1992)			
Absts.	18:6638	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002367	MF-708
CONF-9209256–		(Electric & hybrid vehicle technology TOPTEC workshop; Dearborn, MI (United States); 14-15 Sep 1992)			
	18:5891	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002810	MF-333
CONF-9209257–		(US-Japan workshop on improvement of structural design and construction practices; San Diego, CA (United States); 8-10 Sep 1992)			
1	18:6226	*See* Y/EN–4665			
CONF-9209258–		(Unreinforced hollow clay tile workshop; San Francisco, CA (United States); 21-22 Sep 1992)			
1	18:6227	*See* Y/EN–4765			
2	18:6086	*See* Y/EN–4764			
CONF-9209260–		(Workshop on computational methods for crashworthiness; Hampton, VA (United States); 2-3 Sep 1992)			
1	18:6222	*See* SAND–92-2151C			
CONF-9209261–		(International conference on advances in liquid scintillation; Vienna (Austria); 14-18 Sep 1992)			
1	18:5600	*See* WSRC-MS–92-163			
CONF-9209262–		(NSF/DOE workshop on flow of particles and fluids; Gaithersburg, MD (United States); 17-18 Sep 1992)			
1	18:6230	*See* ANL/MCT/CP–76348			
CONF-9209263–		(3. international conference on calorimetry in high energy physics; Corpus Christi, TX (United States); 29 Sep - 2 oct 1992)			
1	18:6435	*See* SLAC-PUB–5953			
2	18:6376	*See* ANL-HEP-CP–92-94			
3	18:6377	*See* ANL-HEP-CP–92-95			
4	18:6375	*See* ANL-HEP-CP–92-80			
5	18:6425	*See* LA-UR–92-3223			
CONF-9209264–		(NATO Advanced Study Institute on multicomponent and multilayered thin films for advanced microtechnologies, techniques, fundamentals and devices; Bad Windsheim (Germany); 22 Sep - 6 oct 1992)			
1	18:6089	*See* ANL/CHM/CP–73956			
CONF-9209265–		(1992 international meeting on reduced enrichment for research and test reactors; Roskilde (Germany); 27 Sep - 1 oct 1992)			
1	18:5489	*See* ANL/CP–77513			
CONF-9209266–		(1992 international meeting on reduced enrichment for research and test reactors; Roskilde (Denmark); 27 Sep - 1 oct 1992)			
3	18:5066	*See* ANL/EP/CP–77801			
4	18:5444	*See* ANL/EP/CP–77800			
5	18:5490	*See* ANL/EP/CP–77799			
CONF-9209267–		(10. Sagamore conference on charge, spin and momentum densities; Konstanz (Germany); 1-7 Sep 1992)			
1	18:6002	*See* ANL/MSD/CP–77606			
CONF-9209268–		(1992 CECAM workshop; Orsay (France); 7-11 Sep 1992)			
1	18:7246	*See* UCRL-JC–111893			
CONF-9209271–		(3. annual infrared radiometric sensor calibration symposium; Logan, UT (United States); 14-17 Sep 1992)			
1	18:7495	*See* NREL/TP–411-5165			

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CONF-9209274--		(CNRS-NSF collaboration workshop on environments and tools for parallel scientific computing; St. Hilaire du Touvet (France); 7-8 Sep 1992)			
1	18:7449	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003612	MF-405
2	18:7450	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003613	MF-405
CONF-9209276--		(LATTICE '92: lattice field theory; Amsterdam (Netherlands); 15-19 Sep 1992)			
1	18:6904	*See* LA-UR--92-3736			
2	18:6943	*See* LA-UR--92-3857			
3	18:6887	*See* ANL-HEP-CP--92-92			
4	18:6859	*See* ANL-HEP-CP--92-103			
5	18:6889	*See* ANL-HEP-CP--92-113			
CONF-9209279--		(11. international seminar on high energy physics problems; Dubna (Russian Federation); 7-12 Sep 1992)			
1	18:6920	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004158	MF-414
CONF-920930--		(17. symposium on fusion technology; Rome (Italy); 14-18 Sep 1992)			
4	18:7399	*See* LA-UR--92-3001			
14	18:7400	*See* LA-UR--92-3324			
CONF-920938--		(6. international symposium on solar thermal concentrating technologies; Mojacar (Spain); 25 Sep - 2 oct 1992)			
3	18:5288	*See* SAND--92-2123C			
4	18:5306	*See* SAND--92-0300C			
5	18:5296	*See* SAND--92-2189C			
CONF-920947--		(Conference on nanostructured materials; Cancun (Mexico); 21-25 Sep 1992)			
2	18:5918	*See* ANL/MSD/CP--77539			
3	18:5219	*See* ANL/MSD/CP--77538			
4	18:5919	*See* ANL/MSD/CP--77654			
CONF-920948--		(6. international conference on physics of highly charged ions; Manhattan, KS (United States); 28 Sep - 2 oct 1992)			
6	18:7054	*See* ANL/PHY/CP--77423			
7	18:7073	*See* ANL/PHY/CP--77109			
8	18:7060	*See* ANL/PHY/CP--77677			
9	18:7071	*See* UCRL-JC--111467			
10	18:7120	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004109	MF-414
11	18:7070	*See* PNL-SA--21302			
CONF-920951--		(US Department of Energy contractors review meeting on gasification and gas stream cleanup systems; Morgantown, WV (United States); 15-17 Sep 1992)			
8	18:4884	*See* DOE/METC/C--93/7040			
9	18:4881	*See* DOE/MC/29310--93/C0084			
10	18:5340	*See* DOE/MC/29444--93/C0085			
11	18:4879	*See* DOE/MC/27391--93/C0110			
12	18:4868	*See* DOE/MC/26308--93/C0081			
13	18:4856	*See* DOE/MC/24116--93/C0109			
14	18:4869	*See* DOE/MC/26365--93/C0099			
15	18:5230	*See* DOE/ER/81057--93/C0107			
16	18:5357	*See* DOE/MC/25034--93/C0096			
17	18:4847	*See* DOE/ER/80896--93/C0097			
18	18:4855	*See* DOE/MC/23277--93/C0087			
19	18:4939	*See* DOE/MC/21023--93/C0086			
20	18:4873	*See* DOE/MC/27226--93/C0108			
21	18:4866	*See* DOE/MC/26038--93/C0105			
22	18:5339	*See* DOE/MC/29309--93/C0083			
23	18:4878	*See* DOE/MC/27363--93/C0082			
24	18:4872	*See* DOE/MC/27224--93/C0089			
25	18:5359	*See* DOE/MC/27423--93/C0095			
26	18:5358	*See* DOE/MC/27259--93/C0094			
27	18:4850	*See* DOE/MC--93/C0118			
28	18:4846	*See* DOE/ER/80877--93/C0116			
29	18:4858	*See* DOE/MC/25003--93/C0090			
30	18:4877	*See* DOE/MC/27339--93/C0112			
31	18:5231	*See* DOE/MC/10637--93/C0119			
32	18:4859	*See* DOE/MC/25006--93/C0091			
33	18:4895	*See* DOE/SF/00098--93/C0114			

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34	18:4880	*See* DOE/MC/28202–93/C0113			
35	18:4946	*See* DOE/NBM–93000207			
36	18:4857	*See* DOE/MC/24138–93/C0088			
37	18:4852	*See* DOE/MC/23075–93/C0106			
38	18:4876	*See* DOE/MC/27240–93/C0115			
39	18:5354	*See* DOE/ER/81349–93/C0125			
40	18:4861	*See* DOE/MC/25140–93/C0131			
41	18:4875	*See* DOE/MC/27233–93/C0129			
42	18:4848	*See* DOE/ER/80998–93/C0128			
43	18:4845	*See* DOE/ER/80591–93/C0126			
44	18:5338	*See* DOE/FE/61660–93/C0093			
45	18:4849	*See* DOE/ER/81228–93/C0100			
46	18:4932	*See* ANL/CP–76799			
48	18:4867	*See* DOE/MC/26239–93/C0133			
49	18:6095	*See* DOE/MC/23120–93/C0132			
50	18:4874	*See* DOE/MC/27227–93/C0130			
51	18:5356	*See* DOE/MC/23252–93/C0127			
52	18:4870	*See* DOE/MC/26366–93/C0102			
53	18:4871	*See* DOE/MC/26372–93/C0103			
54	18:4851	*See* DOE/MC/10637–93/C0121			
55	18:4898	*See* DOE/MC/10637–93/C0120			
57	18:6096	*See* DOE/MC/26373–93/C0104			
CONF-920966–		(10. conference on computing in high energy physics; Annecy (France); 21-25 Sep 1992)			
3	18:7513	*See* SLAC-PUB–5930			
4	18:6355	*See* SLAC-PUB–5929			
5	18:7503	*See* SLAC-PUB–5923			
6	18:7502	*See* SLAC-PUB–5922			
7	18:7500	*See* SLAC-PUB–5913			
8	18:7501	*See* SLAC-PUB–5921			
9	18:6898	*See* FNAL/C–92/260			
10	18:6384	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003016	MF-414
11	18:6385	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003014	MF-414
12	18:6857	*See* FNAL/C–92/259			
13	18:6326	*See* FNAL/C–92/268			
14	18:6327	*See* FNAL/C–92/269-E			
15	18:6328	*See* FNAL/C–92/277			
16	18:6333	*See* FNAL/C–92/310			
18	18:6363	*See* SSCL-Preprint–175			
CONF-920967–		(Advanced research workshop on non-thermal plasma techniques for pollution control; Cambridge (United Kingdom); 21-25 Sep 1992)			
2	18:4907	*See* SAND–92-1939C			
CONF-920969–		(International symposium on radon and radon reduction technology; Minneapolis, MN (United States); 22-25 Sep 1992)			
2	18:6611	*See* DOE/ER/61029–10			
CONF-920970–		(3. conference on evolution of microstructure in metals during irradiation; Minett (Canada); 29 Sep - 2 oct 1992)			
5	18:5920	*See* ANL/MSD/CP–78010			
CONF-920979–		(1. annual clean coal technology conference; Cleveland, OH (United States); 22-24 Sep 1992)			
	18:4836	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004314	MF-101
CONF-921005–		(Nuclear science symposium; Orlando, FL (United States); 26-31 Oct 1992)			
2	18:6436	*See* SSCL-Preprint–164			
4	18:6357	*See* SLAC-PUB–5987			
5	18:6386	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003619	MF-406
6	18:6440	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003620	MF-404
7	18:6426	*See* LA-UR–92-3330			
9	18:6341	*See* LA-UR–92-3569			
10	18:6427	*See* LA-UR–92-3541			
11	18:6330	*See* FNAL/C–92/296			
15	18:6398	*See* FNAL/C–92/316			
16	18:6394	*See* FNAL/C–92/283			
CONF-921007–		(20. water reactor safety information meeting; Bethesda, MD (United States); 21-23 Oct 1992)			
	18:5633	*See* NUREG/CP–0125			

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3	18:5657	*See* SAND–92-2264C			
CONF-921010–		(11. European photovoltaic solar energy conference and exhibition; Montreux (Switzerland); 12-16 Oct 1992)			
1	18:5307	*See* SAND–92-0604C			
CONF-9210112–		(29. JANNAF combustion meeting; Hampton, VA (United States); 19-23 Oct 1992)			
3	18:6459	*See* SAND–92-2126C			
CONF-9210121–		(Workshop on the production and use of intense radioactive ion beams for the IsoSpin Laboratory; Oak Ridge, TN (United States); 7-10 Oct 1992)			
1	18:7019	*See* LA-UR–92-3806			
2	18:6213	*See* LA-UR–92-3777			
3	18:6300	*See* LA-UR–92-3582			
4	18:6350	*See* LBL–32940			
CONF-9210158–		(Infotech '92; Oak Ridge, TN (United States); 21-23 Oct 1992)			
3	18:7508	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003087	MF-400
CONF-9210165–		(9. AIST-NEDO/DOE-PETC joint technical meeting on coal liquifation; San Francisco, CA (United States); 12-15 Oct 1992)			
2	18:4843	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002339	MF-108
CONF-9210166–		(4. international conference on ultra-wideband, short-pulse electromagnetics; Brooklyn, NY (United States); 8-10 Oct 1992)			
2	18:6455	*See* SAND–92-0765C			
3	18:6212	*See* LA-UR–92-3581			
CONF-9210173–		(Nuclear Energy Agency Science Committee (NEANSC) specialists meeting on evaluation and processing of covariance data; Oak Ridge, TN (United States); 7-9 Oct 1992)			
2	18:7249	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002343	MF-413
3	18:6983	*See* ANL/EP/CP–78013			
CONF-9210176–		(63. shock and vibration symposium; Las Cruces, NM (United States); 27 Oct 1992)			
4	18:6220	*See* SAND–92-1429C			
CONF-9210177–		(1992 Institute of Electrical and Electronic Engineers (IEEE) system, man and cybernetics conference; Chicago, IL (United States); 18-21 Oct 1992)			
2	18:7511	*See* SAND–92-1903C			
CONF-9210178–		(Supercities international conference on environmental quality and sustainable development; San Francisco, CA (United States); 25-30 Oct 1992)			
1	18:6525	*See* LA-UR–92-2919			
CONF-9210185–		(International Atomic Energy Agency (IAEA) workshop on high temperature applications of nuclear energy; Ibaraki-ken (Japan); 19-20 Oct 1992)			
1	18:5411	*See* GA-A–21088			
CONF-9210194–		(International symposium on environmental contamination; Budapest (Hungary); 12-16 Oct 1992)			
1	18:4908	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001637	MF-402
3	18:5201	*See* RFP–4645			
8	18:5722	*See* ANL/ES/CP–77747			
CONF-9210197–		(Department of Energy (DOE) ethanol from biomass annual review meeting; Golden, CO (United States); 28-29 Oct 1992)			
1	18:5235	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002423	MF-246
CONF-9210203–		(40. annual Investment Casting Institute (ICI) technical meeting; Las Vegas, NV (United States); 4-7 Oct 1992)			
1	18:5982	*See* SAND–92-2041C			
2	18:6221	*See* SAND–92-1975C			
3	18:5980	*See* SAND–92-0889C			
CONF-9210204–		(Water reactor safety information meeting; Washington, DC (United States); Oct 1992)			
1	18:5655	*See* SAND–92-1750C			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-9210209–		(Organization for Economic Co-Operation Development/International Atomic Energy Agency/Commision of Safety Nuclear Installations (OECD/IAEA/CSNI) joint international specialists meeting on fracture mechanics verification by large scale testing; Knoxville, TN (United States); 26-29 Oct 1992)			
1	18:5420	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002829	MF-1035
2	18:5390	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003100	
CONF-921021–		(15. world energy engineering congress (WEEC); Atlanta, GA (United States); 13-15 Oct 1992)			
3	18:5736	*See* PNL-SA–21185			
CONF-9210210–		(Colorado Hazardous Waste Management Society annual conference; Denver, CO (United States); Oct 1992)			
1	18:6567	*See* DOE/MC/11076–93/C0080			
CONF-9210211–		(U.S.-Japan joint technical meeting on coal gasification; San Francisco, CA (United States); 10-13 Oct 1992)			
1	18:4882	*See* DOE/METC/C–93/7036			
2	18:4896	*See* PNL-SA–21443			
CONF-9210213–		(1992 Combustion Institute fall meeting of the western states section; Berkeley, CA (United States); 12-13 Oct 1992)			
1	18:6253	*See* LBL–32927			
2	18:6526	*See* LBL–32950			
3	18:6191	*See* LBL–32926			
4	18:6192	*See* LBL–32928			
CONF-9210215–		(Contraband and cargo inspection technology; Washington, DC (United States); 28-30 Oct 1992)			
1	18:6379	*See* ANL/RE/CP–76730			
2	18:7034	*See* ANL/EP/CP–77833			
CONF-9210216–		(Sequent users' resource forum; Atlanta, GA (United States); 26-28 Oct 1992)			
1	18:7440	*See* ANL/MSD/CP–77613			
CONF-9210218–		(Productivity quality conference; Dayton, OH (United States); 21-23 Oct 1992)			
1	18:5822	*See* MLM–3766			
CONF-9210219–		(14. annual North American conference of the International Association for Energy Economics; New Orleans, LA (United States); 26-28 Oct 1992)			
1	18:5017	*See* ANL/EAIS/CP–77643			
CONF-9210220–		(Advanced metalization for ULSI applications in 1992; Tempe, AZ (United States); 20-22 Oct 1992)			
1	18:5983	*See* SAND–92-2298C			
CONF-9210221–		(American Association for Aerosol Research annual meeting; San Francisco, CA (United States); 12-16 Oct 1992)			
1	18:6669	*See* DOE/ER/60592–9			
CONF-9210224–		(13. National Particle Accelerator conference; Dubna (Russian Federation); 13-15 Oct 1992)			
1	18:6314	*See* ANL/EP/CP–77608			
CONF-9210229–		(IEEE scientific supercomputing subcommittee meeting; Livermore, CA (United States); 25 Oct 1992)			
1	18:7490	*See* LA-UR–92-3495			
CONF-9210231–		(26. annual Asilomar conference on signals, systems, and computers; Pacific Grove, CA (United States); 25-30 Oct 1992)			
2	18:6431	*See* LA-UR–92-3646			
CONF-9210232–		(Institute Electrical and Electronic Engineers (IEEE) meeting; Orlando, FL (United States); 26-30 Oct 1992)			
1	18:6428	*See* LA-UR–92-3601			
2	18:6429	*See* LA-UR–92-3602			
3	18:6430	*See* LA-UR–92-3603			
4	18:6331	*See* FNAL/C–92/300			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-9210235–		(National poultry waste symposium; Birmingham, AL (United States); Oct 1992)			
1	18:5831	*See* TVA-Bull–Z-322			
CONF-9210237–		(Near earth objects (NEO) workshop; Los Alamos, NM (United States); Oct 1992)			
1	18:6843	*See* LA-UR–92-3647			
CONF-9210244–		(Pollution prevention conference iron and steel industry; Chicago, IL (United States); 14-15 Oct 1992)			
1	18:5813	*See* ANL/ES/CP–77925			
CONF-9210246–		(1992 accelerator instrumentation workshop; Berkeley, CA (United States); 27-30 Oct 1992)			
1	18:6309	*See* ANL/ASD/CP–77464			
2	18:6307	*See* ANL/ASD/CP–77206			
3	18:6308	*See* ANL/ASD/CP–77462			
4	18:6311	*See* ANL/ASD/CP–77498			
5	18:6310	*See* ANL/ASD/CP–77465			
6	18:6349	*See* LBL–32939			
CONF-921029–		(Annual Department of Energy model conference on waste management and environmental restoration; Oak Ridge, TN (United States); 19-22 Oct 1992)			
8	18:5126	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001714	MF-402
10	18:6556	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001717	MF-902
13	18:5127	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003025	MF-902
CONF-921034–		(US Department of Energy contractors review meeting on coal-fueled heat engines, advanced PFBC and gas stream cleanup systems; Morgantown, WV (United States); 27-28 Oct 1992)			
1	18:4931	*See* ANL/CMT/CP–77193			
2	18:5862	*See* DOE/METC/C–93/7042			
3	18:5360	*See* DOE/METC/C–93/7043			
4	18:4944	*See* DOE/METC/C–93/7045			
5	18:4945	*See* DOE/METC/C–93/7049			
6	18:5342	*See* DOE/METC/C–93/7046			
7	18:6252	*See* DOE/METC/C–93/7050			
CONF-921036–		(182. meeting of the Electrochemical Society; Toronto (Canada); 11-16 Oct 1992)			
10	18:6122	*See* ANL/CMT/CP–77775			
CONF-921037–		(9. annual international Pittsburgh coal conference; Pittsburgh, PA (United States); 12-16 Oct 1992)			
7	18:4883	*See* DOE/METC/C–93/7037			
8	18:5341	*See* DOE/METC/C–93-7038			
CONF-921046–		(Symposium on nuclear data evaluation methodology; Upton, NY (United States); 12-16 Oct 1992)			
6	18:6985	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002828	MF-413
7	18:6995	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003022	MF-413
8	18:6989	*See* ANL/EP/CP–77792			
9	18:6992	*See* BNL–48035			
10	18:5445	*See* ANL/RA/CP–77740			
11	18:7016	*See* LA-UR–92-3404			
12	18:7017	*See* LA-UR–92-3417			
13	18:6981	*See* LA-UR–92-3785			
CONF-921048–		(Human Factors Society (HFS) annual meeting; Atlanta, GA (United States); 12-16 Oct 1992)			
6	18:7498	*See* PNL-SA–20706			
CONF-921049–		(Windpower '92; Seattle, WA (United States); 19-23 Oct 1992)			
4	18:5333	*See* SAND–92-1162C			
5	18:5335	*See* SAND–92-2417C			
CONF-921101–		(Material Research Society fall meeting; Boston, MA (United States); 30 Nov - 5 dec 1992)			
4	18:6457	*See* LA-UR–92-3935			
5	18:5972	*See* LA-UR–92-3715			
8	18:5984	*See* SAND–92-2408C			
9	18:6458	*See* LA-UR–92-3946			
10	18:5932	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004104	MF-114

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
11	18:6259	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004105	MF-404
21	18:5921	*See* ANL/MSD/CP–78164			
CONF-921102–		(Joint American Nuclear Society (ANS)/European Nuclear Society (ENS) international meeting on fifty years of controlled nuclear chain reaction: past, present, and future; Chicago, IL (United States); 15-20 Nov 1992)			
22	18:5203	*See* WSRC-MS–92-305			
27	18:5493	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002429	MF-506
29	18:5423	*See* ANL/MCT/CP–76420			
30	18:5605	*See* ANL/RE/CP–77809			
31	18:5422	*See* ANL/MCT/CP–76404			
35	18:6203	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004118	MF-406
CONF-921104–		(American Institute of Chemical Engineers annual meeting; Miami, FL (United States); 1-6 Nov 1992)			
8	18:4897	*See* TVA-Bull–Z-324			
10	18:4938	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004174	MF-109
CONF-921109–		(Fall meeting of the Metallurgical Society and American Institute of Metallurgical and Petroleum Engineers; Chicago, IL (United States); 1-5 Nov 1992)			
3	18:5922	*See* ANL/RE/CP–75828			
4	18:5916	*See* ANL/FE/CP–75641			
CONF-921110–		(Winter annual meeting of the American Society of Mechanical Engineers (ASME); Anaheim, CA (United States); 8-13 Nov 1992)			
31	18:5760	*See* DOE/ET/10815–201			
32	18:6036	*See* ANL/MCT/CP–77573			
34	18:6652	*See* LA-UR–92-3410			
35	18:6246	*See* IS-M–727			
37	18:6035	*See* ANL/CP–77428			
39	18:6199	*See* ANL/CP–75488			
41	18:5759	*See* ANL/CP–75323			
42	18:5933	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004397	MF-404
CONF-9211114–		(OECD/NEA meeting: international information exchange program on actinide and fission product separation and transmutation; Chicago, IL (United States); 11-13 Nov 1992)			
1	18:5095	*See* ANL/CMT/CP–77849			
CONF-9211115–		(Scientific data management workshop '92; Salt Lake City, UT (United States); 3-5 Nov 1992)			
2	18:6469	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003011	MF-400
CONF-9211116–		(38. annual conference on bioassay, analytical and environmental radiochemistry; Santa Fe, NM (United States); 2-6 Nov 1992)			
2	18:6120	*See* WSRC-MS–92-280			
CONF-9211118–		(International conference on signal processing applications and technology; Boston, MA (United States); 5 Nov 1992)			
1	18:6452	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003085	MF-406
CONF-9211120–		(5. advanced technology conference of the United States Postal Service (USPS); Washington, DC (United States); 30 Nov - 2 dec 1992)			
1	18:7420	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002506	MF-400
CONF-9211124–		(Harshaw/quality systems (HS) 1992 thermoluminescent dosimetry (TLD) user symposium; San Antonio, TX (United States); 9-13 Nov 1992)			
2	18:6696	*See* LA-UR–92-3700			
CONF-9211127–		(Materials Research Society (MRS) meeting; Pittsburgh, PA (United States); 3 Nov - 4 dec 1992)			
1	18:5968	*See* LA-UR–92-3406			
CONF-9211128–		(1992 nuclear explosives code developers conference; Sunnyvale, CA (United States); 2-6 Nov 1992)			
1	18:6463	*See* SAND–92-1880C			
2	18:6848	*See* SAND–92-1707C			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-9211129–		(International Atomic Energy Agency (IAEA) technical meeting on guidelines on probabilistic consequence assessment; Vienna (Austria); 9-13 Nov 1992)			
1	18:6695	*See* LA-UR–92-3651			
CONF-9211130–		(International symposium on spectral sensing research; Maui, HI (United States); 15-20 Nov 1992)			
2	18:6844	*See* LA-UR–92-3789			
3	18:6111	*See* LA-UR–92-3940			
CONF-9211132–		(Symposium on low expansion alloys and composites; Chicago, IL (United States); 1-5 Nov 1992)			
1	18:5979	*See* SAND–92-0400C			
CONF-9211133–		(2. Cinvestav superconductivity symposium; Tequisquiapan (Mexico); 2-6 Nov 1992)			
1	18:6024	*See* LA-UR–92-3808			
CONF-9211135–		(International tungsten symposium; Washington, DC (United States); 16-18 Nov 1992)			
1	18:5967	*See* LA-UR–92-3281			
CONF-9211138–		(U.S. Army COE Research Labatories annual executive manager's conference; Champagne, IL (United States); 3 Nov 1992)			
1	18:7431	*See* SAND–92-2445C			
CONF-9211139–		(Annual meeting of the Regional Science Association International (RSAI); Chicago, IL (United States); 15 Nov 1992)			
1	18:5689	*See* ANL/EAIS/CP–77888			
CONF-921114–		(Fuel cell seminar; Tucson, AZ (United States); 29 Nov - 2 dec 1992)			
1	18:5767	*See* DOE/MC/26355–93/C0137			
3	18:5768	*See* DOE/MC/27227–93/C0136			
CONF-9211140–		(United States/Japan workshop on theory of high beta plasmas; San Diego, CA (United States); 11-13 Nov 1992)			
1-Vugraphs	18:7153	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004170	MF-421
CONF-9211142–		(IEEE lasers and electro-optics Society meeting; Boston, MA (United States); 15-20 Nov 1992)			
1	18:6690	*See* IS-M–730			
CONF-9211144–		(5. United States/Japan workshop on high T_c superconductors; Tsukuba (Japan); 9-10 Nov 1992)			
1	18:7126	*See* ANL/MCT/CP–76909			
2	18:6007	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004169	MF-404; MF-310
CONF-921116–		(12. international conference on the application of accelerators in research and industry; Denton, TX (United States); 2-5 Nov 1992)			
3	18:7052	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002430	MF-411
6	18:7091	*See* EGG–10617-3017			
7	18:7027	*See* SAND–92-1843C			
8	18:7095	*See* SAND–92-1594C			
9	18:6181	*See* BNL–48081			
10	18:6365	*See* UCRL-JC–111197			
11	18:7064	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003013	MF-412
12	18:6972	*See* UCRL-JC–111939			
13	18:6641	*See* BNL–48016			
14	18:5225	*See* LA-UR–92-3496			
15	18:6650	*See* SAND–92-2410C			
16	18:6937	*See* LA-UR–92-3334			
17	18:6285	*See* LA-UR–92-3662			
18	18:6315	*See* ANL/PHY/CP–76643			
19	18:6312	*See* ANL/CP–76440			
CONF-921119–		(American Society for Testing and Materials (ASTM) symposium on application of accelerated corrosion tests to life prediction of materials; Miami, FL (United States); 16-17 Nov 1992)			
1	18:6043	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002425	MF-404

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-921121–		(3. joint conference of European East-West conference on materials and processes and European Materials Research Society fall meeting; Strasbourg (France); 3-6 Nov 1992)			
1	18:6006	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003017	MF-404
CONF-921122–		(Meeting of the Division of Particles and Fields of the American Physics Society; Batavia, IL (United States); 10-14 Nov 1992)			
3	18:6946	*See* SLAC-PUB–5969			
4	18:6948	*See* SLAC-PUB–5997			
5	18:6833	*See* BNL–48171			
6	18:6906	*See* SLAC-PUB–5999			
7	18:6941	*See* LA-UR–92-3788			
8	18:6888	*See* ANL-HEP-CP–92-109			
9	18:6916	*See* ANL-HEP-CP–92-117			
12	18:6950	*See* ANL-HEP-CP–92-124			
CONF-921124–		(5. international symposium on superconductivity; Kobe (Japan); 16-19 Nov 1992)			
1	18:6023	*See* LA-UR–92-3752			
CONF-921125–		(ACM/IEEE supercomputing conference; Minneapolis, MN (United States); 14-21 Nov 1992)			
5	18:7438	*See* ANL/CP–77516			
CONF-921128–		(Ceramic science and technology congress and exposition; San Francisco, CA (United States); 1-4 Nov 1992)			
2	18:5971	*See* LA-UR–92-3682			
4	18:6022	*See* LA-UR–92-3702			
CONF-921130–		(7. international cryocooler conference; Santa Fe, NM (United States); 15-19 Nov 1992)			
1	18:6831	*See* LA-UR–92-3853			
CONF-921133–		(6. international conference on megagauss magnetic field generation and related topics; Albuquerque, NM (United States); 9-12 Nov 1992)			
1	18:7214	*See* LA-UR–92-3774			
2	18:5227	*See* LA-UR–92-3710			
3	18:6214	*See* LA-UR–92-3797			
4	18:7213	*See* LA-UR–92-3765			
5	18:7402	*See* LA-UR–92-3759			
6	18:6267	*See* LA-UR–92-3649			
7	18:7401	*See* LA-UR–92-3711			
CONF-921145–		(Production and neutralization of negative ions and beams; Upton, NY (United States); 9-13 Nov 1992)			
1	18:6342	*See* LA-UR–92-3664			
CONF-921147–		(8. international symposium on ceramics and 2nd national conference on advanced ceramics and exhibition on new ceramic materials; Rimini (Italy); 9-13 Nov 1992)			
1	18:6032	*See* ANL/CP–75338			
CONF-921152–		(International gas research conference; Orlando, FL (United States); 16-19 Nov 1992)			
4	18:5020	*See* ANL/CP–74033			
CONF-921162–		(Hypervelocity impact symposium; Austin, TX (United States); 17-20 Nov 1992)			
11	18:6249	*See* SAND–91-2816C			
14	18:6250	*See* SAND–92-2355C			
15	18:6062	*See* LBL–33020			
CONF-921201–		(Conference on magnetism and magnetic materials; Houston, TX (United States); 1-4 Dec 1992)			
7	18:5923	*See* BNL–48026			
8	18:6034	*See* ANL/CP–76341			
10	18:5914	*See* ANL/CP–76457			
11	18:5915	*See* ANL/CP–76458			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-921209–		(International Association Mathematics and Computers Simulation (IMACS) international symposium on mathematical modelling and computer simulation; Bangalore (India); 7-11 Dec 1992)			
3	18:5443	*See* ANL/CP–75373			
CONF-921210–		(Symposium for high-performance computing for flight vehicles; Washington, DC (United States); 7-9 Dec 1992)			
3	18:6200	*See* ANL/CP–76686			
CONF-921229–		(11. European photovoltaic solar energy conference; Montreaux (Switzerland); 16 Dec 1992)			
1	18:5274	*See* SAND–92-0658C			
CONF-921230–		(National Aeronautics and Space Administration (NASA) technology 2002 conference; Baltimore, MD (United States); 1-3 Dec 1992)			
1	18:6124	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003028	MF-401
CONF-921232–		(2. international seminar on double layer-capacitors and similar energy storage devices; Deerfield, FL (United States); 7-9 Dec 1992)			
1	18:6058	*See* LA-UR–92-3755			
CONF-921233–		(international laser safety conference on non-beam hazards; Cincinnati, OH (United States); 1-4 Dec 1992)			
1	18:6215	*See* LA-UR–92-3837			
CONF-930103–		(10. symposium on space nuclear power and propulsion; Albuquerque, NM (United States); 10-14 Jan 1993)			
11	18:5765	*See* WHC-SA–1590			
13	18:5429	*See* SAND–92-1350C			
14	18:5598	*See* WHC-SA–1586			
16	18:5656	*See* SAND–92-2242C			
17	18:5430	*See* SAND–92-2009C			
20	18:5431	*See* SAND–92-7295C			
CONF-930106–		(31. American Institute of Astronautics and Aeronautics (AIAA) aerospace sciences meeting; Reno, NV (United States); 11-14 Jan 1993)			
2	18:5658	*See* SAND–92-2342C			
CONF-930116–		(Probabilistic safety assessment international topical meeting; Clearwater Beach, FL (United States); 27-29 Jan 1993)			
8	18:5454	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002831	MF-405
9	18:5661	*See* WSRC-MS–92-152			
10	18:5483	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003023	MF-407
12	18:5612	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003097	MF-407
13	18:6284	*See* LA-UR–92-3519			
14	18:6282	*See* LA-UR–92-3438			
17	18:5627	*See* LA-UR–92-3466			
CONF-930136–		(19. annual conference on explosives and blasting techniques and 9th annual symposium on explosives and blasting research; San Diego, CA (United States); 31 Jan - 4 feb 1993)			
1	18:5023	*See* SAND–92-2375C			
CONF-930141–		(9. international conference on interactive information and processing; Anaheim, CA (United States); 17-22 Jan 1993)			
1	18:7437	*See* ANL/CP–77460			
CONF-930150–		(Optical Society of America (OSA) meeting on ultrafast optics and optoelectronics; San Francisco, CA (United States); 25-27 Jan 1993)			
1	18:7124	*See* LBL–32901			
CONF-930151–		(1. Optical Society of America (OSA) meeting on high resolution spectroscopy; Salt Lake City, UT (United States); 18-21 Jan 1993)			
1	18:7074	*See* SAND–92-8629C			
2	18:7075	*See* SAND–93-8401C			
3	18:6193	*See* SAND–93-8402C			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-930152–		(8. annual battery conference on applications and advances; Long Beach, CA (United States); 12-14 Jan 1993)			
1	18:5676	*See* SAND–92-1835C			
CONF-930153–		(12. American Society Mechanical Engineers wind energy symposium; Houston, TX (United States); 31 Jan - 4 feb 1993)			
1	18:5334	*See* SAND–92-1665C			
CONF-930154–		(Symposium on composite material technology; Houston, TX (United States); 31 Jan - 3 feb 1993)			
1	18:6081	*See* UCRL-JC–112024			
CONF-930155–		(PACAM 3; Sao Paolo (Brazil); Jan 1993)			
1	18:6232	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004123	MF-406
CONF-930202–		(Annual meeting of The Metallurgical Society; Denver, CO (United States); 21-25 Feb 1993)			
1	18:6185	*See* RFP–4628			
2	18:6057	*See* LA-UR–92-3596			
3	18:6059	*See* LA-UR–92-3831			
CONF-930219–		(The light metal symposium; Denver, CO (United States); 21-25 Feb 1993)			
1	18:5978	*See* RFP–4610			
CONF-930233–		(9. annual Institute of Electrical and Electronic Engineers (IEEE) semiconductor thermal measurement symposium; Austin, TX (United States); 2-4 Feb 1993)			
1	18:6268	*See* SAND–92-1906C			
CONF-930242–		(National Electronic Packaging in Production (NEPCON) west conference; Anaheim, CA (United States); 9 Feb 1993)			
1	18:6270	*See* SAND–92-2434C			
CONF-930339–		(2. IEEE international conference on fuzzy systems; San Francisco, CA (United States); 28 Mar - 1 apr 1993)			
1	18:6204	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001214	MF-406
CONF-930352–		(2. international conference on nuclear engineering; San Francisco, CA (United States); 21-24 Mar 1993)			
2	18:5663	*See* WSRC-MS–92-288			
3	18:5662	*See* WSRC-MS–92-265			
4	18:5654	*See* SAND–92-1723C			
5	18:5653	*See* SAND–92-1373C			
6	18:5660	*See* WSRC-MS–92-026			
7	18:5601	*See* WSRC-MS–92-285			
CONF-930353–		(10. international Zurich symposium and technical exhibition on electromagnetic compatibility; Zurich (Switzerland); 9-11 Mar 1993)			
1	18:5664	OSTI; NTIS; GPO Dep.	E 1.99:	DE92041257	MF-220
CONF-930354–		(International reliability physics conference; Atlanta, GA (United States); 22-25 Mar 1993)			
1	18:6269	*See* SAND–92-2073C			
CONF-930355–		(Institute of Electrical and Electronic Engineers (IEEE) international conference on neural networks; San Francisco, CA (United States); 28 Mar - 1 apr 1993)			
1	18:6456	*See* SAND–92-2104C			
CONF-930360–		(6. modeling of casting, welding and advanced solidification processes conference; Palm Coast, FL (United States); 21-26 Mar 1993)			
1	18:5934	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001719	MF-404
CONF-930361–		(1993 American Society of Mechanical Engineers (ASME) national design engineering conference; Chicago, IL (United States); 7-11 Mar 1993)			
1	18:6225	*See* WHC-SA–1606			
CONF-930365–		(International conference on discrete element methods; Cambridge, MA (United States); 17-18 Mar 1993)			
2	18:6060	*See* LA-UR–92-3917			

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CONF-930373–		(Society of Plastic Engineers (SPE) meeting; New Orleans, LA (United States); 22-26 Mar 1993)			
1	18:7509	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004110	MF-405
COO–					
40406-5	18:6986	*See* DOE/ER/40406–5			
CRIE-W–					
0384	18:5837	OSTI; NTIS		DE93754079	
CTA-IEAV-RI–					
011/85	18:5228	OSTI; NTIS (US Sales Only); INIS		DE93609327	
CTH-OOK–					
92-04	18:5251	*See* NUTEK-FBT–92-13			
CTH-VB-A–					
23	18:5314	OSTI; NTIS		DE93753077	
DESY–					
92-102	18:6893	OSTI; NTIS (US Sales Only); INIS		DE93742850	
92-107	18:6921	OSTI; NTIS (US Sales Only); INIS		DE93742722	
92-114	18:6922	OSTI; NTIS (US Sales Only); INIS		DE93742851	
92-115	18:6894	OSTI; NTIS (US Sales Only); INIS		DE93742852	
92-116	18:6923	OSTI; NTIS (US Sales Only); INIS		DE93742853	
92-117	18:6895	OSTI; NTIS (US Sales Only); INIS		DE93742855	
92-118	18:6862	OSTI; NTIS (US Sales Only); INIS		DE93742854	
92-121	18:6368	OSTI; NTIS (US Sales Only); INIS		DE93742848	
92-122	18:6924	OSTI; NTIS (US Sales Only); INIS		DE93742849	
DOE-RW–					
89.069	18:5138	OSTI; NTIS (US Sales Only); INIS		DE93609552	
DOE/BC–					
91/4	18:4978	OSTI; NTIS; GPO Dep.	E 1.99:	DE92001052	PC-122
DOE/BP–					
1791	18:5690	*See* DOE/EA–0523			
1964	18:6561	*See* DOE/EA–0791			
1994	18:5264	*See* DOE/EA–0749			
DOE/CE–					
40956T-H1	18:5726	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003688	MF-310
DOE/CE/15361–					
T1	18:6205	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005056	MF-310
DOE/CE/15459–					
T5	18:5016	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003629	MF-334
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T2	18:5935	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005124	MF-310
DOE/CE/15533–					
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DOE/CE/15988–					
T1	18:5725	OSTI; NTIS; GPO Dep.	E 1.99:	DE93006067	MF-310
DOE/CE/23810–					
4A	18:6044	OSTI; NTIS; GPO Dep.	E 1.99:	DE93006427	MF-366
4C	18:6045	OSTI; NTIS; GPO Dep.	E 1.99:	DE93006429	MF-366
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4	18:5791	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93005610	MF-350
5	18:5899	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93005611	MF-334; MF-336
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9	18:6260	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005615	MF-222
10	18:5840	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005617	MF-249
11	18:5236	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005618	MF-249
12	18:5900	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93005620	MF-334; MF-333; MF-336
13-Pt.2	18:5841	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93005621	MF-249
T1	18:5792	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93005619	MF-350
T2	18:5793	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004225	MF-233
DOE/CE/28313–					
T2	18:5794	OSTI; NTIS; GPO Dep.	E 1.99:	DE93006139	MF-350
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3	18:5936	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005212	MF-312
DOE/CE/40917–					
T2	18:6046	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005211	MF-310

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DOE/CE/50280–					
T1	18:5901	OSTI; NTIS; GPO Dep.	E 1.99:	DE93006099	MF-334
DOE/CE/90213–					
T6	18:6187	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003632	MF-362
T7	18:6188	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003631	MF-362
DOE/CH/10378–					
10	18:5128	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93006069	MF-810
DOE/CH/10402–					
18	18:5110	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004583	MF-820
19	18:5111	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004584	MF-820
DOE/DP–					
0105P	18:6453	OSTI; NTIS; GPO Dep.	E 1.99:	DE92041040	MF-700
0111T	18:5096	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005378	MF-700
DOE/DP/48075–					
3	18:7510	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93005057	MF-902
DOE/DP/OAC/VT–					
92A	18:5906	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001562	MF-700
DOE/EA–					
0383	18:6557	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002207	MF-630
0523	18:5690	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002205	MF-630
0533	18:5182	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002209	MF-630
0539	18:6558	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002268	MF-630
0562	18:6606	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000410	MF-630
0594	18:5129	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002211	MF-630
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0621	18:6464	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003869	MF-630
0625-Final-Pub.Com.	18:5184	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002251	MF-630
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0216(91)	18:4992	OSTI; NTIS; INIS; GPO; GPO Dep.	E 1.99:	DE93003986	MF-950
0226(92/10)	18:5745	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE93002634	MF-950
0226(92/11)	18:5746	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE93003713	MF-950
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0520(92/11)	18:4994	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE93004467	MF-950
0520(92/12)	18:4995	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE93005295	MF-950
0535(91)	18:4996	OSTI; NTIS; GPO; INIS; GPO Dep.	E 1.99:	DE93002955	MF-950
0538(92/93-5)	18:4997	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE93002963	MF-950

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0538(92/93-6)	18:4998	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003369	MF-950
0538(92/93-7)	18:4999	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003637	MF-950
0538(92/93-8)	18:5000	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE93002448	MF-950
0538(92/93-9)	18:5001	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004399	MF-950
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0157	18:5694	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003127	MF-630
0157-Exec.Summ.	18:6470	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003128	MF-630
0157-Vol.1	18:6562	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003129	MF-630
0157-Vol.2	18:6563	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003130	MF-630
0157-Vol.3	18:6564	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003131	MF-630
0157-Vol.4	18:6565	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003132	MF-630
0185D-160	18:5185	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003923	MF-902; MF-907
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0089T	18:6087	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004627	MF-902
0095P	18:5132	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001758	MF-902
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0184/8	18:5727	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002233	MF-400
0535P/1	18:5728	OSTI; NTIS; GPO Dep.	E 1.99:	DE92041170	PC-400
0568T	18:6471	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004891	PC-402
0572T	18:7371	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004626	MF-420
0573P	18:6793	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004826	PC-403
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0003	18:7378	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003281	MF-420
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DOE/ER/12108–					
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DOE/ER/12114–					
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DOE/ER/12117–					
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DOE/ER/12809–					
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DOE/ER/12824–					
1	18:5470	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001622	MF-405
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14	18:5471	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003082	MF-406
DOE/ER/12930–					
1	18:5472	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004605	MF-406
DOE/ER/13331–					
T4	18:6197	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005126	MF-406
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DOE/ER/13504–					
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DOE/ER/13507–					
8	18:6092	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005883	MF-401
DOE/ER/13529–					
7	18:6126	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005291	MF-401
DOE/ER/13549–					
7	18:7065	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93005918	MF-411
DOE/ER/13580–					
T2	18:4844	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005719	MF-401
DOE/ER/13649–					
T2	18:6127	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005960	MF-401
DOE/ER/13654–					
6	18:6128	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005133	MF-401
DOE/ER/13690–					
5	18:5238	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005924	MF-408
DOE/ER/13735–					
T1	18:7372	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001704	MF-406
DOE/ER/13764–					
10	18:6233	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000921	MF-406
DOE/ER/13766–					
10	18:6168	OSTI; NTIS; GPO Dep.	E 1.99:	DE93006505	MF-401

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DOE/ER/13777–5	18:6129	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005720	MF-401
DOE/ER/13836–5	18:6130	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005646	MF-401
DOE/ER/13848–5	18:6131	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005885	MF-401
DOE/ER/13935–T1	18:6132	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005125	MF-401
DOE/ER/13954–4	18:6133	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005884	MF-401
DOE/ER/13958–30	18:7056	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93005117	MF-411
DOE/ER/14035–T2	18:5937	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005917	MF-401
DOE/ER/14048–T4	18:6134	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005063	MF-401
DOE/ER/14053–T3	18:6189	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005250	MF-401
DOE/ER/14105–3	18:6169	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005928	MF-401
DOE/ER/14128–2	18:6190	OSTI; NTIS; GPO Dep.	E 1.99:	DE93006185	MF-401
DOE/ER/14130–2	18:6047	OSTI; NTIS; GPO Dep.	E 1.99:	DE93006183	MF-401
DOE/ER/14201–1	18:6794	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003163	MF-403
DOE/ER/14262–1	18:6609	OSTI; NTIS; GPO Dep.	E 1.99:	DE93006000	MF-401
DOE/ER/20028–T2	18:6633	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004901	MF-408
DOE/ER/20050–1	18:6634	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005999	MF-408
DOE/ER/25016–T1	18:7451	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005049	MF-405
DOE/ER/25106–1-Vol.1	18:7452	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004993	MF-405
1-Vol.2	18:7453	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004994	MF-405
DOE/ER/40150–195	18:6854	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93000830	MF-414
197	18:6925	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93000829	MF-414
DOE/ER/40156–T1	18:7373	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004599	MF-415
DOE/ER/40302–7	18:6293	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004600	MF-414
DOE/ER/40319–T2	18:6855	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004641	MF-414
DOE/ER/40353–15	18:6962	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004377	MF-413
DOE/ER/40364–T1	18:6926	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002785	MF-413
DOE/ER/40372–3	18:6387	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93005576	MF-414
DOE/ER/40406–5	18:6986	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004602	MF-413
DOE/ER/40448–5	18:6951	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003714	MF-413
DOE/ER/40577–3	18:6896	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93005923	MF-414
DOE/ER/40579–T1	18:6388	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93000937	MF-414
DOE/ER/40608–2	18:6963	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93005941	MF-413
DOE/ER/40609–2	18:6964	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004950	MF-413
DOE/ER/40617–129	18:6863	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001920	MF-414
DOE/ER/40621–2	18:6952	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93005116	MF-414
DOE/ER/40633–2	18:6856	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93005112	MF-414

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DOE/ER/45120–11	18:6135	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005065	MF-401
DOE/ER/45188–8	18:5938	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005647	MF-404
DOE/ER/45223–1	18:6008	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93006089	MF-404
DOE/ER/45266–T3	18:7128	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005052	MF-404
DOE/ER/45324–T2	18:7081	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93005090	MF-410
DOE/ER/45374–1	18:6136	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005115	MF-401
DOE/ER/45404–3	18:6048	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005881	MF-404
DOE/ER/45423–3	18:5939	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005132	MF-404
DOE/ER/45427–3	18:7129	OSTI; NTIS; GPO Dep.	E 1.99:	DE93006146	MF-404
DOE/ER/45454–T1	18:5940	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93005676	MF-410
DOE/ER/51115–T1	18:7374	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93006521	MF-420
DOE/ER/52111–5	18:7375	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004563	MF-420
DOE/ER/52130–T3	18:7156	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93006068	MF-421
DOE/ER/52134–T2	18:7157	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93005089	MF-421
DOE/ER/53216–13	18:7158	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93005922	MF-427
DOE/ER/53218–21	18:7159	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93005129	MF-427
DOE/ER/53264–3	18:7376	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93005130	MF-420
DOE/ER/54071–T3	18:7160	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93006123	MF-427
T4	18:7161	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93006124	MF-427
T5	18:7162	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93006125	MF-427
DOE/ER/54084–T1	18:7377	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93005008	MF-426
DOE/ER/54139–1	18:7163	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002365	MF-420
DOE/ER/60401–3	18:6642	OSTI; NTIS; GPO Dep.	E 1.99:	DE93006145	MF-407
DOE/ER/60524–6	18:6668	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93005873	MF-408
DOE/ER/60592–9	18:6669	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003162	MF-408
DOE/ER/60648–5	18:6137	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005920	MF-401
DOE/ER/60678–5	18:6670	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93006077	MF-408
DOE/ER/60688–5	18:6635	OSTI; NTIS; GPO Dep.	E 1.99:	DE93006149	MF-408
DOE/ER/60691–1	18:6639	OSTI; NTIS; GPO Dep.	E 1.99:	DE93006081	MF-408
DOE/ER/60971–3	18:6472	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005114	MF-407
DOE/ER/61010–1	18:6610	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93005061	MF-402
2	18:6473	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93005062	MF-402
DOE/ER/61029–10	18:6611	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002248	MF-402
DOE/ER/61192–1	18:6612	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003278	MF-403
DOE/ER/61204–2	18:6093	OSTI; NTIS; GPO Dep.	E 1.99:	DE93006084	MF-401
DOE/ER/61245–1	18:6640	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005046	MF-408
DOE/ER/61443–1	18:6613	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004646	MF-406

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DOE/ER/75585–					
2	18:6094	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005128	MF-406
DOE/ER/75639–					
1	18:5842	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93005315	MF-400
DOE/ER/75645–					
1	18:5857	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005058	MF-400
DOE/ER/75682–					
1-Pt.6	18:5678	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001490	MF-400
DOE/ER/80591–					
93/C0126	18:4845	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003208	MF-106
DOE/ER/80877–					
93/C0116	18:4846	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002603	MF-109
DOE/ER/80895–					
93/C0097	18:4847	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002709	MF-106
DOE/ER/80995–					
93/C0128	18:4848	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003207	MF-106
DOE/ER/81057–					
93/C0107	18:5230	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002604	MF-107
DOE/ER/81228–					
93/C0100	18:4849	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002731	MF-406
DOE/ER/81229–					
93/C0100	18:4849	*See* DOE/ER/81228–93/C0100			
DOE/ER/81349–					
93/C0125	18:5354	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000211	MF-114
DOE/ET–					
53088-577	18:6835	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002161	MF-422
53088-583	18:7165	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003635	MF-420
DOE/ET/10815–					
201	18:5760	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002657	MF-112
DOE/ET/15601–					
43	18:5761	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005919	MF-112
DOE/ET/53088–					
576	18:7379	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002167	MF-422
578	18:7164	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003634	MF-427
DOE/FE/61660–					
93/C0093	18:5338	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002730	MF-106
DOE/FE/61662–					
93/C0093	18:5338	*See* DOE/FE/61660–93/C0093			
DOE/FE/61680–					
H2	18:5355	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004313	MF-101
DOE/ID–					
12082(91)	18:6671	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003642	MF-502
DOE/ID/12584–					
103	18:5186	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002870	MF-902
104	18:5045	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002872	MF-511
T2	18:6566	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002871	MF-902
DOE/ID/12624–					
1	18:5941	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000906	PC-310
DOE/ID/12692–					
2	18:5815	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001351	PC-310
DOE/ID/12726–					
T4	18:5816	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004947	MF-311
DOE/ID/12869–					
T1	18:5942	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005813	MF-312
DOE/ID/12905–					
T3	18:5817	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003284	PC-314
DOE/ID/12917–					
T1	18:5818	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003283	PC-314
DOE/ID/12945–					
2	18:5311	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000933	MF-253
T6	18:5310	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005643	MF-253
DOE/IG–					
0316	18:5064	OSTI (Free of Charge); INIS		TI93004477	PC-960
DOE/IR/05106–					
4	18:5844	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005625	MF-249
6	18:5845	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005627	MF-249
2-Vol.2	18:5843	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005622	MF-249
T160	18:5902	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005623	MF-334
T161	18:5846	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93005624	MF-350
DOE/LC/11084–					
3150	18:5025	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004828	MF-123

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DOE/LLW–					
152	18:5133	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93005068	MF-940
DOE/MC–					
93/C0118	18:4850	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000208	MF-106
DOE/MC/10637–					
93/C0119	18:5231	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002608	MF-106; MF-107
93/C0120	18:4898	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004095	MF-106
93/C0121	18:4851	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004094	MF-106; MF-107
DOE/MC/11076–					
93/C0080	18:6567	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002713	MF-123
DOE/MC/21023–					
93/C0086	18:4939	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002615	MF-103
DOE/MC/22118–					
3148	18:4909	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003987	MF-107
DOE/MC/23075–					
3149	18:4853	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004061	MF-113; MF-109
3151	18:4854	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004068	MF-113; MF-109
93/C0106	18:4852	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003202	MF-109
DOE/MC/23120–					
93/C0132	18:6095	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003483	MF-106
DOE/MC/23252–					
93/C0127	18:5356	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003484	MF-106
DOE/MC/23277–					
93/C0087	18:4855	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002614	MF-106
DOE/MC/24116–					
93/C0109	18:4856	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002746	MF-109
DOE/MC/24138–					
93/C0088	18:4857	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003201	MF-109
DOE/MC/24221–					
3144	18:5766	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003490	MF-110
DOE/MC/24257–					
3153	18:5860	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002680	MF-111
DOE/MC/25003–					
93/C0090	18:4858	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002612	MF-106
DOE/MC/25006–					
93/C0091	18:4859	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002607	MF-106
DOE/MC/25020–					
3126	18:4860	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000206	PC-109
DOE/MC/25034–					
93/C0096	18:5357	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002710	MF-114
DOE/MC/25115–					
3114	18:5011	OSTI; NTIS; GPO Dep.	E 1.99:	DE92012457	PC-122
3115	18:5012	OSTI; NTIS; GPO Dep.	E 1.99:	DE92012458	PC-122
3116	18:5013	OSTI; NTIS; GPO Dep.	E 1.99:	DE92012463	PC-122
DOE/MC/25137–					
3104	18:4940	OSTI; NTIS; GPO Dep.	E 1.99:	DE92001299	PC-103
3127	18:4941	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93000212	PC-103
DOE/MC/25140–					
3159	18:4862	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004820	MF-109; MF-110
3160	18:4863	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004819	MF-103; MF-106; MF-109; MF-110
93/C0131	18:4861	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003205	MF-106
DOE/MC/25201–					
3124	18:4864	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000204	PC-106
DOE/MC/25204–					
3133	18:4865	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000217	PC-114
DOE/MC/26038–					
93/C0105	18:4866	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002617	MF-114
DOE/MC/26039–					
3111	18:6138	OSTI; NTIS; GPO Dep.	E 1.99:	DE92012454	PC-108
DOE/MC/26052–					
3140	18:5861	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000224	MF-111
DOE/MC/26239–					
93/C0133	18:4867	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003200	MF-106

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DOE/MC/26308–					
93/C0081	18:4868	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002745	MF-109
DOE/MC/26355–					
93/C0137	18:5767	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003489	MF-110
DOE/MC/26365–					
93/C0099	18:4869	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002605	MF-109
DOE/MC/26366–					
93/C0102	18:4870	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004098	MF-106
DOE/MC/26372–					
93/C0103	18:4871	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004086	MF-106
DOE/MC/26373–					
93/C0104	18:6096	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002824	MF-106
DOE/MC/27224–					
93/C0089	18:4872	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002613	MF-106
DOE/MC/27226–					
93/C0108	18:4873	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002616	MF-109
DOE/MC/27227–					
93/C0130	18:4874	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003486	MF-110
93/C0136	18:5768	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003485	MF-110
DOE/MC/27233–					
93/C0129	18:4875	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003206	MF-105
DOE/MC/27240–					
93/C0115	18:4876	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003203	MF-109
DOE/MC/27259–					
93/C0094	18:5358	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002711	MF-103
DOE/MC/27339–					
93/C0112	18:4877	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002610	MF-109
DOE/MC/27363–					
93/C0082	18:4878	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002619	MF-109
DOE/MC/27364–					
93/C0078	18:4942	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002219	MF-103
DOE/MC/27391–					
93/C0110	18:4879	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002744	MF-109
DOE/MC/27423–					
93/C0095	18:5359	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002712	MF-103
DOE/MC/28055–					
93/C0135	18:5769	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003488	MF-110
DOE/MC/28079–					
3131	18:5010	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000216	PC-132
DOE/MC/28202–					
93/C0113	18:4880	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002742	MF-109
DOE/MC/29309–					
93/C0083	18:5339	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002618	MF-109
DOE/MC/29310–					
93/C0084	18:4881	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002741	MF-109; MF-102
DOE/MC/29444–					
93/C0085	18:5340	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002743	MF-109
DOE/METC/C–					
93-7038	18:5341	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002399	MF-106; MF-109
93/7036	18:4882	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002397	MF-109
93/7037	18:4883	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002398	MF-101
93/7039	18:4943	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002396	MF-103; MF-115
93/7040	18:4884	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002395	MF-106; MF-109
93/7042	18:5862	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003193	MF-111
93/7043	18:5360	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003197	MF-106
93/7045	18:4944	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003198	MF-105
93/7046	18:5342	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003199	MF-101
93/7049	18:4945	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003481	MF-105
93/7050	18:6252	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003494	MF-111
DOE/NASA/0030–					
9	18:6049	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003887	PC-373
DOE/NASA/0335–					
4	18:5863	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004126	MF-336
DOE/NBM–					
93000207	18:4946	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000207	MF-106
93000208	18:4850	*See* DOE/MC–93/C0118			
93000210	18:4932	*See* ANL/CP–76799			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DOE/NE/37963–					
21	18:5943	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005059	MF-504
22	18:5944	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93005060	MF-504
DOE/NE/37964–					
1	18:5473	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93005044	MF-507
DOE/NP/00119–					
1	18:7421	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93005327	MF-1000
DOE/NV–					
357-Ver.1	18:6568	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002394	MF-700
DOE/NV/10845–					
T2	18:6569	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005916	MF-703
DOE/OR/21400–					
T472	18:4899	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004463	PC-114
DOE/OR/21548–					
160	18:5185	*See* DOE/EIS–0185D-160			
DOE/OSTI–					
3406(Suppl.3)(Add.1)	18:5134	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE92016339	PC-814
DOE/PC/79672–					
T4	18:5762	OSTI; NTIS; GPO Dep.	E 1.99:	DE93006008	MF-112
DOE/PC/79796–					
T29	18:4947	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004945	MF-105
DOE/PC/79798–					
T26	18:5361	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001722	PC-105
DOE/PC/79924–					
T6	18:5362	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004919	MF-105
DOE/PC/88812–					
T15	18:4885	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004915	MF-108
DOE/PC/88920–					
T24	18:4886	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004939	MF-102
DOE/PC/89652–					
T8	18:5363	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005988	MF-105
DOE/PC/89659–					
T10	18:4948	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004941	MF-104
DOE/PC/89768–					
T10	18:5367	OSTI; NTIS; GPO Dep.	E 1.99:	DE93006134	MF-105
T11	18:5368	OSTI; NTIS; GPO Dep.	E 1.99:	DE93006135	MF-105
T12	18:5369	OSTI; NTIS; GPO Dep.	E 1.99:	DE93006136	MF-105
T7	18:5364	OSTI; NTIS; GPO Dep.	E 1.99:	DE93006131	MF-105
T8	18:5365	OSTI; NTIS; GPO Dep.	E 1.99:	DE93006132	MF-105
T9	18:5366	OSTI; NTIS; GPO Dep.	E 1.99:	DE93006133	MF-105
DOE/PC/89883–					
57	18:4900	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004918	PC-108
DOE/PC/90033–					
22	18:4887	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004920	PC-108
DOE/PC/90038–					
T2	18:4949	OSTI; NTIS; GPO Dep.	E 1.99:	DE93006127	MF-102
T3	18:4950	OSTI; NTIS; GPO Dep.	E 1.99:	DE93006128	MF-102
T4	18:4951	OSTI; NTIS; GPO Dep.	E 1.99:	DE93006129	MF-102
T5	18:4952	OSTI; NTIS; GPO Dep.	E 1.99:	DE93006130	MF-102
DOE/PC/90098–					
T7	18:5343	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004938	MF-105
T8	18:5344	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004937	MF-105
DOE/PC/90169–					
T7	18:4953	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005086	MF-104
DOE/PC/90182–					
T7	18:6234	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004936	MF-117
DOE/PC/90185–					
T5	18:6235	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004935	MF-117
T6	18:6236	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004934	MF-117
T7	18:6237	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004933	MF-117
DOE/PC/90258–					
T1-Vol.1	18:4837	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005136	MF-104
T1-Vol.2	18:4838	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005137	MF-104
DOE/PC/90290–					
8	18:4901	OSTI; NTIS; GPO Dep.	E 1.99:	DE93006009	MF-102
9	18:4902	OSTI; NTIS; GPO Dep.	E 1.99:	DE93006010	MF-102
DOE/PC/90295–					
T8	18:4839	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004946	MF-105
DOE/PC/90300–					
T7	18:4888	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004932	MF-113

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DOE/PC/90363–					
T6	18:4954	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004360	MF-105
DOE/PC/91026–					
T5	18:4889	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004931	MF-108
DOE/PC/91039–					
T4	18:4890	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004930	MF-108
DOE/PC/91042–					
T2	18:4891	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004362	MF-108
DOE/PC/91155–					
T1	18:5345	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004952	MF-112
DOE/PC/91161–					
T2	18:4955	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005987	MF-104
DOE/PC/91280–					
T5	18:4840	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004929	MF-102
DOE/PC/91287–					
6	18:4892	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005990	MF-108
DOE/PC/91292–					
T4	18:4956	OSTI; NTIS; GPO Dep.	E 1.99:	DE93006004	MF-104
DOE/PC/91295–					
T4	18:4905	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004928	MF-107
DOE/PC/91296–					
4	18:4903	OSTI; NTIS; GPO Dep.	E 1.99:	DE93006012	MF-113
DOE/PC/91301–					
4	18:4893	OSTI; NTIS; GPO Dep.	E 1.99:	DE93006011	MF-108
DOE/PC/91303–					
T3	18:6139	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004927	MF-102
DOE/PC/91311–					
T4	18:4894	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004925	MF-113
DOE/PC/92151–					
T1	18:5370	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004953	MF-105
DOE/RL–					
88-35	18:5187	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003388	MF-630
88-36	18:5188	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003389	MF-630
90-12-Rev.1	18:5135	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002044	MF-630; MF-721
91-36-Rev.1	18:7422	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002052	MF-502
92-21	18:5136	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002048	MF-630
92-26-2	18:6614	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002250	MF-702
DOE/RW–					
0006-Rev.8	18:5137	INIS; OSTI (Free of Charge)		TI93005041	MF-810
0363-TG	18:5140	OSTI (Free of Charge); INIS		TI93002391	MF-800
0380P	18:5116	OSTI (Free of Charge)		TI93004888	MF-800
DOE/RW/00264–					
T2	18:5139	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93005501	MF-812
DOE/S–					
00097P-Vol.1	18:5189	OSTI; NTIS; INIS; GPO; GPO Dep.	E 1.99:	DE93005892	MF-902
00097P-Vol.2	18:5190	OSTI; NTIS; INIS; GPO; GPO Dep.	E 1.99:	DE93004731	MF-902
0099P	18:5735	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002234	MF-940
DOE/SF/00098–					
93/C0114	18:4895	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002609	MF-109
DOE/SF/16306–					
34	18:5289	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005795	MF-231
DOE/SF/18852–					
T19	18:5764	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002035	MF-528
DOE/SR/15160–					
5	18:6615	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004305	MF-403
DOE/ST–					
0002P	18:5679	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003282	MF-900
DOE/WIPP–					
92-050	18:5141	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004293	MF-721
DPSPU–					
74-124-5-Rev.2	18:6207	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003182	MF-707
DPW–					
53-129	18:6672	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93004348	MF-701
53-614	18:5495	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002372	MF-700
53-661	18:5142	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002724	MF-700
53-675	18:5613	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002726	MF-700
53-676	18:5614	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002725	MF-706
53-7-4	18:5494	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002371	MF-700
5365	18:5421	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93001245	MF-700
5430	18:5474	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93001462	MF-700

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DTH-DCAMM–					
441	18:6257	OSTI; NTIS		DE93752739	
DTH-IMSOR-RR–					
1991-2	18:5847	OSTI; NTIS		DE93752970	
1991-21	18:5848	OSTI; NTIS		DE93752969	
DTH-LBM-TR–					
91-250	18:5371	OSTI; NTIS		DE93752746	
DTH-LET-RE–					
91-5	18:6474	OSTI; NTIS		DE93752748	
DTH-LV–					
230	18:5292	OSTI; NTIS		DE93752749	
91-4	18:5303	OSTI; NTIS		DE93752988	
91-5	18:5308	OSTI; NTIS		DE93752991	
91-13	18:5290	OSTI; NTIS		DE93752990	
91-17	18:5291	OSTI; NTIS		DE93752992	
91-22	18:5304	OSTI; NTIS		DE93752989	
92-10	18:5309	OSTI; NTIS		DE93752971	
DUN–					
1174-RD	18:5496	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE92040102	MF-711
ECN-C–					
91-075	18:6673	OSTI; NTIS; INIS		DE93609530	
92-032	18:6475	OSTI; NTIS (US Sales Only)		DE93752679	
92-053	18:5770	OSTI; NTIS (US Sales Only)		DE93752676	
92-054	18:5319	OSTI; NTIS (US Sales Only)		DE93752680	
ECN-I–					
92-037	18:5681	OSTI; NTIS (US Sales Only)		DE93752677	
ECN-RX–					
92-035	18:4957	OSTI; NTIS (US Sales Only)		DE93752678	
EDF-R–					
92-NI-M-0007	18:5795	OSTI; NTIS (US Sales Only)		TI93756214	
92-NI-V-0007	18:5268	OSTI; NTIS (US Sales Only)		TI93756197	
EGG–					
10617-3017	18:7091	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002238	MF-706
2664-Vol.2	18:5638	*See* NUREG/CR–5813-Vol.2			
EGG-BNCT–					
10016-05/06	18:6643	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003686	MF-408
EGG-EP–					
10296	18:5695	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003719	MF-333
EGG-NTAP–					
6175	18:5455	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003077	
EMF–					
11-Vol.1	18:4987	*See* DOE/EI/20479–T3-Vol.1			
11-Vol.2	18:4988	*See* DOE/EI/20479–T3-Vol.2			
9-Vol.1	18:4989	*See* DOE/EI/20479–T4-Vol.1			
9-Vol.2	18:5018	*See* DOE/EI/20479–T4-Vol.2			
9-Vol.3	18:5019	*See* DOE/EI/20479–T4-Vol.3			
ENEL-CRTN-T6–					
91-05	18:5372	OSTI; NTIS (US Sales Only)		DE93748425	
91-13	18:5346	OSTI; NTIS (US Sales Only)		DE93748436	
ENSLAPP-A–					
385/92	18:6923	*See* DESY–92-116			
ER-B–					
92-07	18:7423	OSTI (Free of Charge)		TI93004278	PC-960
92-08	18:7415	OSTI (Free of Charge)		TI93002181	PC-960
93-01	18:5007	OSTI (Free of Charge)		TI93005575	PC-960
ES/ER/TM–					
40	18:5191	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001422	MF-902
41	18:5143	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000554	MF-902
ESG–					
176	18:6345	*See* LBL–32178			
177	18:6286	*See* LBL–32182			
180	18:6287	*See* LBL–32220			
181	18:6301	*See* LBL–32221			
183	18:6288	*See* LBL–32223			
184	18:6346	*See* LBL–32232			
186	18:6302	*See* LBL–32286			
206	18:6373	*See* LBL–32559			
211	18:6349	*See* LBL–32939			
212	18:6350	*See* LBL–32940			
ESH-EMS–					
92-0035	18:6570	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93006398	MF-702

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
ESM–					
38	18:7057	OSTI; NTIS (US Sales Only); INIS		DE93610148	
39	18:7058	OSTI; NTIS (US Sales Only); INIS		DE93610149	
40	18:6996	OSTI; NTIS (US Sales Only); INIS		DE93610072	
41	18:6987	OSTI; NTIS (US Sales Only); INIS		DE93610049	
42	18:6988	OSTI; NTIS (US Sales Only); INIS		DE93610050	
43	18:6965	OSTI; NTIS (US Sales Only); INIS		DE93609993	
44	18:7066	OSTI; NTIS (US Sales Only); INIS		DE93610179	
45	18:6997	OSTI; NTIS (US Sales Only); INIS		DE93610073	
46	18:6799	OSTI; NTIS (US Sales Only); INIS		DE93609832	
47	18:7067	OSTI; NTIS (US Sales Only); INIS		DE93610180	
ESTSC–					
000312SUN0001	18:7454	ESTSC			
000321IPCAT00	18:7455	ESTSC			
000424MNFRM00	18:7456	ESTSC			
000431IBMPC00	18:7457	ESTSC			
000435CY0MP00	18:7458	ESTSC			
000444IPS0200	18:7459	ESTSC			
000472I036000	18:7460	RADIATION SHIELDING INFORMATION CENTER			
000504C360000	18:7461	ESTSC			
000505I308100	18:7462	ESTSC			
000506C017000	18:7463	ESTSC			
000549I036000	18:7464	ESTSC			
000550IBMPC00	18:7465	ESTSC			
ESTSC/NRC–					
000075C017000	18:7466	ESTSC			
000075I303300	18:7467	ESTSC			
000075IBMPC00	18:7468	ESTSC			
ESTSC/NRC/R–					
000126C760000	18:7469	ESTSC			
000126CY00100	18:7470	ESTSC			
000143CYYMP00	18:7471	ESTSC			
000143I309000	18:7472	ESTSC			
000146I303300	18:7473	ESTSC			
000147I303300	18:7474	ESTSC			
000148I036000	18:7475	ESTSC			
000150I303X00	18:7476	ESTSC			
ETDE-IT–					
92-100	18:5260	OSTI; NTIS (US Sales Only); INIS		DE93748440	
92-101	18:5667	OSTI; NTIS (US Sales Only); INIS		DE93748422	
92-102	18:5347	OSTI; NTIS (US Sales Only)		DE93748423	
92-103	18:5348	OSTI; NTIS (US Sales Only)		DE93748424	
92-104	18:7477	OSTI; NTIS (US Sales Only)		DE93748437	
92-97	18:6243	OSTI; NTIS (US Sales Only); INIS		DE93748438	
92-98	18:6244	OSTI; NTIS (US Sales Only); INIS		DE93748439	
92-99	18:5665	OSTI; NTIS (US Sales Only)		DE93748399	
ETDE-mf–					
93742624	18:5684	OSTI; NTIS (US Sales Only)		DE93742624	
93742653	18:5729	OSTI; NTIS (US Sales Only)		DE93742653	
93742657	18:5696	OSTI; NTIS (US Sales Only)		DE93742657	
93742658	18:5685	OSTI; NTIS (US Sales Only)		DE93742658	
93742697	18:6479	OSTI; NTIS (US Sales Only)		DE93742697	
93742725	18:6140	OSTI; NTIS (US Sales Only)		DE93742725	
93742727	18:4906	OSTI; NTIS (US Sales Only)		DE93742727	
93742728	18:5946	OSTI; NTIS (US Sales Only)		DE93742728	
93742738	18:5320	OSTI; NTIS (US Sales Only)		DE93742738	
93742750	18:6465	OSTI; NTIS (US Sales Only)		DE93742750	
93742759	18:5006	OSTI; NTIS (US Sales Only)		DE93742759	
93742761	18:6480	OSTI; NTIS (US Sales Only)		DE93742761	
93744267	18:6481	OSTI; NTIS (US Sales Only)		DE93744267	
93744268	18:5697	OSTI; NTIS (US Sales Only)		DE93744268	
93744281	18:6482	OSTI; NTIS (US Sales Only)		DE93744281	
93744297	18:6141	OSTI; NTIS (US Sales Only)		DE93744297	
93744298	18:5680	OSTI; NTIS (US Sales Only)		DE93744298	
93744300	18:5698	OSTI; NTIS (US Sales Only)		DE93744300	
93744301	18:5682	OSTI; NTIS (US Sales Only)		DE93744301	
93744304	18:4979	OSTI; NTIS (US Sales Only)		DE93744304	
93744305	18:5233	OSTI; NTIS (US Sales Only)		DE93744305	
93744309	18:5699	OSTI; NTIS (US Sales Only)		DE93744309	
93744322	18:5700	OSTI; NTIS (US Sales Only)		DE93744322	

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93744328	18:6483	OSTI; NTIS (US Sales Only)		DE93744328	
93744366	18:6713	OSTI; NTIS (US Sales Only)		DE93744366	
93744391	18:5239	OSTI; NTIS (US Sales Only)		DE93744391	
93744396	18:5316	OSTI; NTIS (US Sales Only)		DE93744396	
93744397	18:6050	OSTI; NTIS (US Sales Only)		DE93744397	
93744398	18:6484	OSTI; NTIS (US Sales Only)		DE93744398	
93744399	18:5819	OSTI; NTIS (US Sales Only)		DE93744399	
93744410	18:5349	OSTI; NTIS (US Sales Only)		DE93744410	
93744439	18:5240	OSTI; NTIS (US Sales Only)		DE93744439	
93744440	18:5701	OSTI; NTIS (US Sales Only)		DE93744440	
93744441	18:5241	OSTI; NTIS (US Sales Only)		DE93744441	
93744442	18:5305	OSTI; NTIS (US Sales Only)		DE93744442	
93744443	18:5796	OSTI; NTIS (US Sales Only)		DE93744443	
93744484	18:5702	OSTI; NTIS (US Sales Only)		DE93744484	
93744509	18:5947	OSTI; NTIS (US Sales Only)		DE93744509	
93744511	18:5242	OSTI; NTIS (US Sales Only)		DE93744511	
93744513	18:7416	OSTI; NTIS (US Sales Only)		DE93744513	
93744514	18:5747	OSTI; NTIS (US Sales Only)		DE93744514	
93744519	18:6051	OSTI; NTIS (US Sales Only)		DE93744519	
93744522	18:6485	OSTI; NTIS (US Sales Only)		DE93744522	
93744609	18:6719	OSTI; NTIS (US Sales Only)		DE93744609	
93744915	18:5279	OSTI; NTIS (US Sales Only)		DE93744915	
93744925	18:6486	OSTI; NTIS (US Sales Only)		DE93744925	
93744926	18:6487	OSTI; NTIS (US Sales Only)		DE93744926	
93750259	18:6488	OSTI; NTIS (US Sales Only)		DE93750259	
93750301	18:5674	OSTI; NTIS (US Sales Only)		DE93750301	
93750598	18:6720	OSTI; NTIS (US Sales Only)		DE93750598	
93750622	18:5820	OSTI; NTIS (US Sales Only)		DE93750622	
93750624	18:5683	OSTI; NTIS (US Sales Only)		DE93750624	
93750629	18:5021	OSTI; NTIS (US Sales Only)		DE93750629	
93750639	18:5286	OSTI; NTIS (US Sales Only)		DE93750639	
93750643	18:5287	OSTI; NTIS (US Sales Only)		DE93750643	
93750680	18:6721	OSTI; NTIS (US Sales Only)		DE93750680	
93750690	18:6722	OSTI; NTIS (US Sales Only)		DE93750690	
93750693	18:6654	OSTI; NTIS (US Sales Only)		DE93750693	
93750839	18:5948	OSTI; NTIS (US Sales Only)		DE93750839	
93750851	18:4910	OSTI; NTIS (US Sales Only)		DE93750851	
93750990	18:6489	OSTI; NTIS (US Sales Only)		DE93750990	
ETDE/JP-mf–					
93753679	18:6476	OSTI; NTIS		DE93753679	
93753763	18:6819	OSTI; NTIS		DE93753763	
93753796	18:5864	OSTI; NTIS		DE93753796	
ETDE/NL-mf–					
93752684	18:4968	OSTI; NTIS (US Sales Only)		DE93752684	
ETSU-B–					
1248	18:5243	OSTI; NTIS (US Sales Only)		DE93756632	
1284-P1	18:5248	OSTI; NTIS (US Sales Only)		DE93756631	
ETSU-S–					
1163/SBS/7	18:5293	OSTI; NTIS (US Sales Only)		DE93756628	
ETSU-TID–					
4101	18:5312	OSTI; NTIS (US Sales Only)		DE93756629	
4101B	18:5313	OSTI; NTIS (US Sales Only)		DE93756630	
ETSU-WN–					
6022	18:5321	OSTI; NTIS (US Sales Only)		DE93756634	
6043	18:5322	OSTI; NTIS (US Sales Only)		DE93756633	
FCR–					
12383	18:5766	*See* DOE/MC/24221–3144			
FEI–					
2108	18:5463	OSTI; NTIS (US Sales Only); INIS		DE93609451	
FEMP/SUB–					
054	18:6097	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002942	MF-701
FFA-TN–					
92-21	18:5328	*See* NUTEK-VIND–92-9			
FNAL-TM–					
1798	18:6399	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004713	PC-414
1799	18:6400	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004712	PC-414
1810	18:6401	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004388	PC-414
1811	18:6334	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93005616	PC-414
FNAL/C–					
92/187	18:6294	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002509	MF-414
92/227	18:6324	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002818	MF-414

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92/252-E	18:6927	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004739	MF-414
92/253-E	18:6897	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002819	MF-414
92/257	18:6325	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004408	MF-414
92/259	18:6857	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004409	MF-405
92/260	18:6898	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002510	MF-414
92/262	18:6928	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004410	MF-414
92/263-E	18:6389	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004411	MF-414
92/268	18:6326	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004412	MF-405; MF-414
92/269-E	18:6327	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004413	MF-414
92/273	18:6390	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004414	MF-414
92/274	18:6391	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004415	MF-414
92/275	18:6392	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004416	MF-414
92/276	18:6393	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004417	MF-414
92/277	18:6328	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004418	MF-405; MF-414
92/283	18:6394	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004420	MF-414
92/287-E	18:6929	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004421	MF-414
92/291	18:6329	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004422	MF-414
92/296	18:6330	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004423	MF-414; MF-405
92/297-E	18:6953	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004740	MF-414
92/300	18:6331	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004424	MF-405; MF-414
92/301	18:6938	*See* LA-UR–92-3489			
92/302	18:6930	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004742	MF-414
92/304	18:6332	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004744	MF-414
92/305	18:6395	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004745	MF-414
92/306	18:6396	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004746	MF-414
92/307	18:6397	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004747	MF-414
92/310	18:6333	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004749	MF-414
92/316	18:6398	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004750	MF-414
FOA-D–					
20177-4.3	18:5484	OSTI; NTIS; INIS		DE93609203	
FPA–					
91-4	18:7398	*See* KFK–5051			
FS–					
92-62-AKURA	18:6674	OSTI; NTIS (US Sales Only); INIS		DE93742868	
FSU-SCRI–					
92C-168	18:6889	*See* ANL-HEP-CP–92-113			
FTINT–					
16-89	18:6675	OSTI; NTIS (US Sales Only); INIS		DE93609133	
31-89	18:6013	OSTI; NTIS (US Sales Only); INIS		DE93609032	
FZR–					
92-03	18:6977	OSTI; NTIS (US Sales Only); INIS		DE93742661	
FhG-IWM-W–					
6/91	18:5949	OSTI; NTIS (US Sales Only)		DE93742731	
7/91	18:5950	OSTI; NTIS (US Sales Only); INIS		DE93744378	
GA-A–					
20978	18:7167	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002962	MF-426
21044	18:7380	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002675	MF-421
21045	18:7381	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002677	MF-421
21053	18:7168	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002674	MF-420
21055	18:7169	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002676	MF-421
21088	18:5411	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001418	MF-522
GARRETT–					
31-8071(04)	18:5863	*See* DOE/NASA/0335–4			
GJPO-ES–					
6	18:5045	*See* DOE/ID/12584–104			
GKSS–					
92/E/18	18:5951	OSTI; NTIS (US Sales Only)		DE93744884	
GRS–					
91	18:5144	OSTI; NTIS (US Sales Only); INIS		DE93744379	
92	18:5615	OSTI; NTIS (US Sales Only); INIS		DE93742737	
GRS-TN-SRR–					
89-01	18:6238	OSTI; NTIS (US Sales Only)		DE93742625	
GSF–					
11/92	18:6616	OSTI; NTIS (US Sales Only)		DE93742862	
26/91	18:6741	OSTI; NTIS (US Sales Only)		DE93742762	
3/92	18:5145	OSTI; NTIS (US Sales Only); INIS		DE93742646	
32/90	18:5146	OSTI; NTIS (US Sales Only); INIS		DE93744280	

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
35/91	18:5147	OSTI; NTIS (US Sales Only); INIS		DE93744279	
4/92	18:6723	OSTI; NTIS (US Sales Only); INIS		DE93750725	
5/92	18:6492	OSTI; NTIS (US Sales Only)		DE93742654	
7/91	18:6571	OSTI; NTIS (US Sales Only)		DE93742813	
GSF-HY–					
1/92	18:7417	OSTI; NTIS (US Sales Only); INIS		DE93742814	
GSF-TL–					
2/92	18:5145	*See* GSF–3/92			
25/91	18:5147	*See* GSF–35/91			
8/92	18:5146	*See* GSF–32/90			
GSI–					
92-07	18:6402	OSTI; NTIS (US Sales Only); INIS		DE93742846	
92-08	18:6335	OSTI; NTIS (US Sales Only); INIS		DE93742919	
92-09	18:7069	OSTI; NTIS (US Sales Only); INIS		DE93742920	
92-10	18:6966	OSTI; NTIS (US Sales Only); INIS		DE93742845	
92-11	18:6998	OSTI; NTIS (US Sales Only); INIS		DE93742677	
92-12	18:6403	OSTI; NTIS (US Sales Only); INIS		DE93744613	
92-13	18:6999	OSTI; NTIS (US Sales Only); INIS		DE93744615	
92-14	18:7000	OSTI; NTIS (US Sales Only); INIS		DE93744614	
92-15	18:6967	OSTI; NTIS (US Sales Only); INIS		DE93744562	
92-20	18:7001	OSTI; NTIS (US Sales Only); INIS		DE93744564	
92-22	18:7002	OSTI; NTIS (US Sales Only); INIS		DE93744565	
92-37(prepr.)	18:6978	OSTI; NTIS (US Sales Only); INIS		DE93742678	
92-59(prepr.)	18:6864	OSTI; NTIS (US Sales Only); INIS		DE93742798	
92-61(prepr.)	18:6865	OSTI; NTIS (US Sales Only); INIS		DE93742800	
92-62(prepr.)	18:7003	OSTI; NTIS (US Sales Only); INIS		DE93742799	
GTFR–					
102	18:7170	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002318	MF-420
103	18:7171	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002319	MF-420
HW–					
11867	18:5499	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002495	MF-520
18385	18:5192	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93000322	MF-502
20002-Del.	18:5067	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003431	MF-520
25470	18:5500	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003393	MF-500
26705-Del.	18:5068	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003394	MF-520
27331	18:5476	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003432	MF-520
27950	18:5501	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003435	MF-520
28171	18:5502	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003436	MF-520
28531	18:5503	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003437	MF-520
28784	18:5504	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003439	MF-520
29802	18:5505	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003438	MF-520
3-2441	18:5497	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003390	MF-500
30150	18:5506	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003441	MF-520
30589-Pt.1	18:6098	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002579	MF-501
30959	18:5507	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003173	MF-700
31519	18:5508	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003396	MF-500
32372	18:5509	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003399	MF-500
32958-RD	18:5485	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93001730	MF-600
33093-RD	18:5069	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003442	MF-520
34095	18:5510	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003400	MF-520
34486	18:5511	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003401	MF-520
36573	18:5616	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003402	MF-520
36762	18:5512	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003403	MF-520
36898	18:5513	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003405	MF-520
36920	18:5514	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003404	MF-520
37304	18:5617	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003406	MF-520
37658-Del.	18:5515	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002503	MF-500
37694	18:5516	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003407	MF-520
38071	18:5477	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003408	MF-520
38221	18:5478	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003409	MF-520
40694	18:5517	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003443	MF-520
43140	18:5479	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003410	MF-520
43456	18:5518	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003444	MF-520
45102	18:5519	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003411	MF-520
46757-Del.	18:5520	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003412	MF-520
47150	18:5480	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003934	MF-520
50072	18:5070	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003445	MF-520
50339-Del.	18:5071	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93004484	MF-500
50572-Del.	18:5072	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003413	MF-520
51228	18:5521	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003446	MF-520
51782	18:5073	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003447	MF-520

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
52300	18:5074	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003448	MF-520
52382	18:5522	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003449	MF-520
52833	18:5075	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003450	MF-520
52859-Del.	18:5076	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93004485	MF-500
53725	18:5077	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003451	MF-520
54745	18:5078	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003516	MF-520
55195	18:5079	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003517	MF-500
55582	18:5080	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003518	MF-500
55940	18:5081	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003452	MF-520
56618	18:5082	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003453	MF-520
56816-RD	18:5618	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003454	MF-520
57111	18:5083	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003455	MF-520
57185-RD	18:5486	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003520	MF-520
57385	18:5084	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003521	MF-500
57702	18:5085	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003522	MF-500
58142	18:5523	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003523	MF-500
58482	18:5086	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003524	MF-500
59085	18:5524	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002501	MF-520
61736-Del.	18:5097	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003043	MF-500
62861	18:5525	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002498	MF-520
63487	18:5526	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003414	MF-711
64576-Del.	18:5098	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93001607	MF-500
66858-RD-2	18:5481	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003527	MF-706
67286-Del.	18:5527	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003962	MF-700
67681	18:5528	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003177	MF-700
68039	18:5529	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003456	MF-700
68343	18:5530	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003528	MF-700
69080	18:5531	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003529	MF-700
69491	18:5532	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003530	MF-700
7-4038	18:5498	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003391	MF-520
7-4167	18:5475	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003392	MF-500
70211	18:5533	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003531	MF-700
70625	18:5534	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003532	MF-700
70952	18:5535	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003501	MF-700
71187-Del.	18:5099	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93004395	MF-500
71230	18:5536	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003302	MF-700
71910	18:5537	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003570	MF-700
72154-Del.	18:5100	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93004396	MF-500
72567	18:5538	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003502	MF-700
72813	18:5539	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003457	MF-700
74101	18:5540	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003573	MF-700
74309	18:5541	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003574	MF-700
74780	18:5542	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003575	MF-700
75089	18:5543	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003415	MF-700
75692	18:5544	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003504	MF-700
75931	18:5545	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003175	MF-700
76398	18:5546	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003176	MF-700
76769	18:5547	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003577	MF-700
76814	18:5548	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003578	MF-520
77045	18:5549	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003954	MF-700
77499	18:5550	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003957	MF-700
77749	18:5551	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003958	MF-700
78029	18:5552	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003959	MF-700
78034	18:5553	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003416	MF-520
78451	18:5554	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003418	MF-700
78490	18:5555	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003505	MF-520
78780	18:5556	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003960	MF-700
78805	18:5557	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003419	MF-520
79070	18:5558	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003961	MF-700
79107-Del.	18:5559	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003963	MF-520
79411	18:5560	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003417	MF-700
79448-Del.	18:5561	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003964	MF-520
79757	18:5562	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003420	MF-700
79769	18:5563	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003580	MF-520
80171	18:5564	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003965	MF-520
80559-2	18:5566	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003429	MF-520
80559-3	18:5567	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003421	MF-520
80559-4	18:5568	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003430	MF-520
80559-5	18:5569	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003422	MF-520
80559-7	18:5571	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003423	MF-520
80559-9	18:5573	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003424	MF-520

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
80559-1-Del.	18:5565	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003966	MF-520
80559-10-Del.	18:5574	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003969	MF-520
80559-11	18:5575	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003425	MF-520
80559-12	18:5576	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003426	MF-520
80559-6-Del.	18:5570	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003967	MF-520
80559-8-Del.	18:5572	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003968	MF-520
80581	18:5577	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003507	MF-700
81000	18:5578	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003581	MF-700
81001	18:5579	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003582	MF-700
81002	18:5580	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003583	MF-700
81003	18:5581	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003508	MF-700
81004	18:5582	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003509	MF-510
82940	18:5583	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003458	MF-700
82942	18:5584	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003427	MF-700
82944	18:5585	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003459	MF-700
82945	18:5586	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003428	MF-700
HY/SPL-E–					
4/1991	18:5858	OSTI; NTIS		DE93711150	
IA–					
1462	18:6497	OSTI; NTIS (US Sales Only); INIS		DE93609128	
1469	18:6836	OSTI; NTIS (US Sales Only); INIS		DE93609872	
1471	18:7424	OSTI; NTIS (US Sales Only); INIS		DE93609217	
IAEA-AL–					
056	18:6099	OSTI; NTIS (US Sales Only); INIS		DE93608744	
059	18:6100	OSTI; NTIS (US Sales Only); INIS		DE93608774	
IAEA-CN–					
56/A-5-2	18:7380	*See* GA-A–21044			
56/D-2-4	18:7151	*See* CONF-920913–19			
56/D-2-1(C)	18:7152	*See* CONF-920913–24			
56/D-4-17	18:7169	*See* GA-A–21055			
IAEA-R–					
5147-F	18:7044	OSTI; NTIS (US Sales Only); INIS		DE93610127	
5179-F	18:6617	OSTI; NTIS (US Sales Only); INIS		DE93609097	
5468-F	18:6498	OSTI; NTIS (US Sales Only); INIS		DE93609101	
5901-F	18:6655	OSTI; NTIS (US Sales Only); INIS		DE93609185	
6687-F	18:6404	OSTI; NTIS (US Sales Only); INIS		DE93609494	
IAEA-TECDOC–					
663	18:5432	OSTI; NTIS (US Sales Only); INIS		DE93609749	
664	18:6677	OSTI; NTIS (US Sales Only); INIS		DE93609214	
665	18:5385	OSTI; NTIS (US Sales Only); INIS		DE93609447	
IEA-PUB–					
519	18:5416	OSTI; NTIS (US Sales Only); INIS		DE93609477	
IEE-IC–					
92	18:5737	OSTI; NTIS		DE93754080	
IEN–					
23/91	18:7045	OSTI; NTIS (US Sales Only); INIS		DE93610128	
25/91	18:5424	OSTI; NTIS (US Sales Only); INIS		DE93609484	
26/91	18:5425	OSTI; NTIS (US Sales Only); INIS		DE93609485	
27/91	18:7478	OSTI; NTIS (US Sales Only); INIS		DE93609814	
28/91	18:6678	OSTI; NTIS (US Sales Only); INIS		DE93609218	
29/91	18:6278	OSTI; NTIS (US Sales Only); INIS		DE93609372	
30/91	18:6405	OSTI; NTIS (US Sales Only); INIS		DE93609495	
32/91	18:5426	OSTI; NTIS (US Sales Only); INIS		DE93609486	
34/92	18:5401	OSTI; NTIS (US Sales Only); INIS		DE93609466	
36/92	18:6052	OSTI; NTIS (US Sales Only); INIS		DE93609444	
37/92	18:6406	OSTI; NTIS (US Sales Only); INIS		DE93609515	
38/92	18:5449	OSTI; NTIS (US Sales Only); INIS		DE93609445	
39/92	18:6183	OSTI; NTIS (US Sales Only); INIS		DE93608881	
40/92	18:5402	OSTI; NTIS (US Sales Only); INIS		DE93609467	
IEN-DERE–					
01/86	18:6239	OSTI; NTIS (US Sales Only); INIS		DE93609341	
IFP–					
40036	18:6143	OSTI; NTIS (US Sales Only)		TI93756239	
IFPILM–					
2/90	18:7172	OSTI; NTIS (US Sales Only); INIS		DE93610249	
IFSR–					
576	18:7379	*See* DOE/ET/53088–576			
577	18:6835	*See* DOE/ET–53088-577			
578	18:7164	*See* DOE/ET/53088–578			
583	18:7165	*See* DOE/ET–53088-583			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
IFT-P–					
002/92	18:6866	OSTI; NTIS (US Sales Only); INIS		DE93609884	
003/92	18:6867	OSTI; NTIS (US Sales Only); INIS		DE93609916	
004/92	18:6801	OSTI; NTIS (US Sales Only); INIS		DE93609833	
020/92	18:6868	OSTI; NTIS (US Sales Only); INIS		DE93609917	
022/92	18:6931	OSTI; NTIS (US Sales Only); INIS		DE93609973	
023/92	18:6932	OSTI; NTIS (US Sales Only); INIS		DE93609974	
024/92	18:6802	OSTI; NTIS (US Sales Only); INIS		DE93609834	
026/92	18:6869	OSTI; NTIS (US Sales Only); INIS		DE93609918	
027/92	18:6899	OSTI; NTIS (US Sales Only); INIS		DE93609932	
028/92	18:6870	OSTI; NTIS (US Sales Only); INIS		DE93609885	
029/92	18:6900	OSTI; NTIS (US Sales Only); INIS		DE93609939	
031/92	18:6803	OSTI; NTIS (US Sales Only); INIS		DE93609835	
032/92	18:6804	OSTI; NTIS (US Sales Only); INIS		DE93609836	
033/92	18:6805	OSTI; NTIS (US Sales Only); INIS		DE93609837	
IKM–					
003	18:6014	OSTI; NTIS (US Sales Only); INIS		DE93742844	
IMM–					
6-92	18:5672	OSTI; NTIS		DE93753067	
INEL/MISC–					
92070	18:5133	*See* DOE/LLW–152			
INIS-BR–					
2949	18:5450	OSTI; NTIS (US Sales Only); INIS		DE93609446	
2952	18:5952	OSTI; NTIS (US Sales Only); INIS		DE93608937	
2979	18:5403	OSTI; NTIS (US Sales Only); INIS		DE93609468	
2991	18:6144	OSTI; NTIS (US Sales Only); INIS		DE93608799	
2994	18:5953	OSTI; NTIS (US Sales Only); INIS		DE93608948	
2995	18:5954	OSTI; NTIS (US Sales Only); INIS		DE93608949	
2996	18:5955	OSTI; NTIS (US Sales Only); INIS		DE93608950	
2998	18:5029	OSTI; NTIS (US Sales Only); INIS		DE93609084	
3009	18:6679	OSTI; NTIS (US Sales Only); INIS		DE93609177	
3031	18:7004	OSTI; NTIS (US Sales Only); INIS		DE93610063	
3056	18:6680	OSTI; NTIS (US Sales Only); INIS		DE93609227	
3060	18:6572	OSTI; NTIS (US Sales Only); INIS		DE93609078	
3061	18:6408	OSTI; NTIS (US Sales Only); INIS		DE93609516	
3062	18:6184	OSTI; NTIS (US Sales Only); INIS		DE93608882	
3063	18:7046	OSTI; NTIS (US Sales Only); INIS		DE93610129	
3064	18:5221	OSTI; NTIS (US Sales Only); INIS		DE93609329	
3065	18:7092	OSTI; NTIS (US Sales Only); INIS		DE93610321	
3066	18:5956	OSTI; NTIS (US Sales Only); INIS		DE93608951	
3067	18:6145	OSTI; NTIS (US Sales Only); INIS		DE93608800	
3068	18:6573	OSTI; NTIS (US Sales Only); INIS		DE93609068	
3069	18:6101	OSTI; NTIS (US Sales Only); INIS		DE93608751	
3070	18:6574	OSTI; NTIS (US Sales Only); INIS		DE93609069	
3076	18:6102	OSTI; NTIS (US Sales Only); INIS		DE93608791	
3082	18:7425	OSTI; NTIS (US Sales Only); INIS		DE93609822	
3083	18:5591	OSTI; NTIS (US Sales Only); INIS		DE93609488	
3086	18:6103	OSTI; NTIS (US Sales Only); INIS		DE93608792	
3087	18:6104	OSTI; NTIS (US Sales Only); INIS		DE93608752	
3088	18:6575	OSTI; NTIS (US Sales Only); INIS		DE93608793	
3089	18:6656	OSTI; NTIS (US Sales Only); INIS		DE93609186	
3090	18:6105	OSTI; NTIS (US Sales Only); INIS		DE93608753	
3091	18:7382	OSTI; NTIS (US Sales Only); INIS		DE93610309	
3092	18:6644	OSTI; NTIS (US Sales Only); INIS		DE93609305	
3096	18:6106	OSTI; NTIS (US Sales Only); INIS		DE93608775	
3103	18:5222	OSTI; NTIS (US Sales Only); INIS		DE93609335	
3104	18:5223	OSTI; NTIS (US Sales Only); INIS		DE93609336	
3105	18:6175	OSTI; NTIS (US Sales Only); INIS		DE93608909	
3106	18:6176	OSTI; NTIS (US Sales Only); INIS		DE93608910	
3107	18:6177	OSTI; NTIS (US Sales Only); INIS		DE93608911	
3108	18:5224	OSTI; NTIS (US Sales Only); INIS		DE93609337	
3109	18:6178	OSTI; NTIS (US Sales Only); INIS		DE93608912	
3111	18:6179	OSTI; NTIS (US Sales Only); INIS		DE93608913	
3112	18:6968	OSTI; NTIS (US Sales Only); INIS		DE93609952	
INIS-GB–					
454	18:6272	OSTI; NTIS (US Sales Only); INIS		DE93609366	
455	18:6273	OSTI; NTIS (US Sales Only); INIS		DE93609367	
456	18:7426	OSTI; NTIS (US Sales Only); INIS		DE93609823	
457	18:6681	OSTI; NTIS (US Sales Only); INIS		DE93609228	
458	18:6682	OSTI; NTIS (US Sales Only); INIS		DE93609229	
459	18:6683	OSTI; NTIS (US Sales Only); INIS		DE93609230	

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460	18:6684	OSTI; NTIS (US Sales Only); INIS		DE93609231	
INIS-SU–					
322	18:5959	OSTI; NTIS (US Sales Only); INIS		DE93608959	
323	18:6016	OSTI; NTIS (US Sales Only); INIS		DE93609000	
324/A	18:6647	OSTI; NTIS (US Sales Only); INIS		DE93609263	
325/A	18:5960	OSTI; NTIS (US Sales Only); INIS		DE93608958	
INIS-XN–					
393	18:5150	OSTI; NTIS (US Sales Only); INIS		DE93609565	
394	18:5209	OSTI; NTIS (US Sales Only); INIS		DE93609753	
396	18:7515	OSTI; NTIS (US Sales Only); INIS		DE93609767	
397	18:7516	OSTI; NTIS (US Sales Only); INIS		DE93609768	
398	18:5210	OSTI; NTIS (US Sales Only); INIS		DE93609754	
399	18:5211	OSTI; NTIS (US Sales Only); INIS		DE93609755	
400	18:5621	OSTI; NTIS (US Sales Only); INIS		DE93609756	
401	18:5433	OSTI; NTIS (US Sales Only); INIS		DE93609750	
405	18:5212	OSTI; NTIS (US Sales Only); INIS		DE93609757	
406	18:5213	OSTI; NTIS (US Sales Only); INIS		DE93609771	
407	18:7517	OSTI; NTIS (US Sales Only); INIS		DE93609769	
408	18:5214	OSTI; NTIS (US Sales Only); INIS		DE93609758	
409	18:5215	OSTI; NTIS (US Sales Only); INIS		DE93609759	
410	18:5622	OSTI; NTIS; INIS		DE93609765	
411	18:5216	OSTI; NTIS; INIS		DE93609760	
412	18:6688	OSTI; NTIS (US Sales Only); INIS		DE93609772	
415	18:5151	OSTI; NTIS (US Sales Only); INIS		DE93609566	
416	18:5152	OSTI; NTIS (US Sales Only); INIS		DE93609567	
417	18:5153	OSTI; NTIS (US Sales Only); INIS		DE93609568	
419	18:5739	OSTI; NTIS (US Sales Only); INIS		DE93609587	
420	18:5154	OSTI; NTIS (US Sales Only); INIS		DE93609570	
424	18:6689	OSTI; NTIS (US Sales Only); INIS		DE93609219	
INIS-mf–					
13389	18:6657	OSTI; NTIS (US Sales Only); INIS		DE93609187	
13391	18:7047	OSTI; NTIS (US Sales Only); INIS		DE93610130	
13392	18:5592	OSTI; NTIS (US Sales Only); INIS		DE93609489	
13394	18:6658	OSTI; NTIS (US Sales Only); INIS		DE93609196	
13395	18:6687	OSTI; NTIS (US Sales Only); INIS		DE93609142	
13396	18:5487	OSTI; NTIS (US Sales Only); INIS		DE93609204	
13399	18:6645	OSTI; NTIS (US Sales Only); INIS		DE93609262	
14086	18:6030	OSTI		TI93742630	
14087	18:5386	OSTI; NTIS (US Sales Only); INIS		DE93744269	
14088	18:6053	OSTI; NTIS (US Sales Only); INIS		DE93744270	
14089	18:7427	OSTI; NTIS (US Sales Only); INIS		DE93744412	
14090	18:7428	OSTI; NTIS (US Sales Only); INIS		DE93744411	
14093	18:6767	OSTI; NTIS (US Sales Only); INIS		DE93744510	
14094	18:5620	OSTI; NTIS (US Sales Only); INIS		DE93742867	
14095	18:6646	OSTI; NTIS (US Sales Only); INIS		DE93742640	
14096	18:5958	OSTI; NTIS (US Sales Only); INIS		DE93742647	
14097	18:6576	OSTI; NTIS (US Sales Only); INIS		DE93744854	
14098	18:5149	OSTI; NTIS (US Sales Only); INIS		DE93744914	
14099	18:6015	OSTI; NTIS (US Sales Only); INIS		DE93744508	
14100	18:5417	OSTI; NTIS (US Sales Only); INIS		DE93750334	
14101	18:7142	OSTI; NTIS (US Sales Only); INIS		DE93750348	
14102	18:5418	OSTI; NTIS (US Sales Only); INIS		DE93750331	
14103	18:6245	OSTI; NTIS (US Sales Only); INIS		DE93750343	
14104	18:6830	OSTI; NTIS (US Sales Only); INIS		DE93750346	
14105	18:6796	OSTI; NTIS (US Sales Only); INIS		DE93750855	
14106	18:6369	OSTI; NTIS (US Sales Only); INIS		DE93750860	
14107	18:6858	OSTI; NTIS (US Sales Only); INIS		DE93750942	
INP–					
1552/PH	18:6902	OSTI; NTIS (US Sales Only); INIS		DE93609944	
INPE–					
2361	18:6618	OSTI; NTIS (US Sales Only); INIS		DE93609099	
4546	18:7186	OSTI; NTIS (US Sales Only); INIS		DE93610279	
4550	18:7187	OSTI; NTIS (US Sales Only); INIS		DE93610280	
5228	18:7188	OSTI; NTIS (US Sales Only); INIS		DE93610246	
5259	18:7189	OSTI; NTIS (US Sales Only); INIS		DE93610281	
5359	18:6837	OSTI; NTIS (US Sales Only); INIS		DE93609873	
5375	18:7190	OSTI; NTIS (US Sales Only); INIS		DE93610282	
INS–					
918	18:6874	OSTI; NTIS; INIS		DE93753080	
919	18:6448	OSTI; NTIS; INIS		DE93753169	
920	18:6336	OSTI; NTIS; INIS		DE93753168	

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
922	18:6337	OSTI; NTIS; INIS		DE93753100	
931	18:6370	OSTI; NTIS; INIS		DE93754287	
932	18:6875	OSTI; NTIS; INIS		DE93754192	
933	18:6933	OSTI; NTIS; INIS		DE93753245	
934	18:6934	OSTI; NTIS; INIS		DE93753247	
939	18:6409	OSTI; NTIS; INIS		DE93754294	
940	18:7006	OSTI; NTIS; INIS		DE93754288	
941	18:7007	OSTI; NTIS; INIS		DE93754289	
INS-T–					
507	18:6280	OSTI; NTIS; INIS		DE93753135	
513	18:6876	OSTI; NTIS; INIS		DE93754136	
IPP–					
1/269	18:7191	OSTI; NTIS (US Sales Only); INIS		DE93742847	
IS–					
5076	18:5204	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004432	MF-906
IS-M–					
721	18:7053	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004446	MF-401
727	18:6246	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004447	MF-404
729	18:6017	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004443	MF-404; MF-406
730	18:6690	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002545	MF-910
IS-T–					
1597	18:6054	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004801	MF-404
1608	18:6018	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003051	MF-401
1632	18:6148	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004461	MF-401
ITER/US–					
92/EN-SD-01	18:7378	*See* DOE/ER-ITER–0003			
ITP–					
91-26	18:6877	OSTI; NTIS (US Sales Only); INIS		DE93609887	
IVL-B–					
1052	18:6500	OSTI; NTIS		DE93753075	
1055	18:6501	OSTI; NTIS		DE93753074	
1065	18:5703	OSTI; NTIS; INIS		DE93753056	
1066	18:5704	OSTI; NTIS; INIS		DE93753057	
IYaF–					
90-102	18:6371	OSTI; NTIS (US Sales Only); INIS		DE93609425	
90-107	18:6806	OSTI; NTIS (US Sales Only); INIS		DE93609838	
90-109	18:6807	OSTI; NTIS (US Sales Only); INIS		DE93609839	
90-127	18:6295	OSTI; NTIS (US Sales Only); INIS		DE93609382	
90-129	18:6372	OSTI; NTIS (US Sales Only); INIS		DE93609426	
90-143	18:7192	OSTI; NTIS (US Sales Only); INIS		DE93610283	
90-71	18:6903	OSTI; NTIS (US Sales Only); INIS		DE93609940	
91-107	18:6338	OSTI; NTIS (US Sales Only); INIS		DE93609403	
JAERI–					
1324	18:7008	OSTI; NTIS; INIS		DE93753275	
1327	18:7479	OSTI; NTIS; INIS		DE93753274	
JAERI-M–					
92-063	18:7387	OSTI; NTIS; INIS		DE93753132	
92-064	18:7193	OSTI; NTIS; INIS		DE93753158	
92-066	18:7388	OSTI; NTIS; INIS		DE93753130	
92-069	18:7389	OSTI; NTIS; INIS		DE93753131	
92-070	18:7390	OSTI; NTIS; INIS		DE93753157	
92-072	18:5623	OSTI; NTIS; INIS		DE93753190	
92-078	18:6208	OSTI; NTIS; INIS		DE93753186	
92-080	18:6838	OSTI; NTIS; INIS		DE93753187	
92-081	18:6247	OSTI; NTIS; INIS		DE93753189	
92-083	18:7391	OSTI; NTIS; INIS		DE93753270	
92-084	18:7480	OSTI; NTIS; INIS		DE93753191	
92-085	18:6954	OSTI; NTIS; INIS		DE93753271	
92-086	18:5961	OSTI; NTIS; INIS		DE93753188	
92-089	18:7481	OSTI; NTIS; INIS		DE93753272	
92-090	18:5419	OSTI; NTIS; INIS		DE93754285	
92-091	18:5155	OSTI; NTIS; INIS		DE93753266	
92-093	18:7392	OSTI; NTIS; INIS		DE93753285	
92-094	18:7393	OSTI; NTIS; INIS		DE93753267	
92-097	18:5593	OSTI; NTIS; INIS		DE93754286	
92-098	18:5594	OSTI; NTIS; INIS		DE93753273	
92-100	18:7394	OSTI; NTIS; INIS		DE93753302	
92-102	18:6502	OSTI; NTIS; INIS		DE93753303	
92-103	18:5595	OSTI; NTIS; INIS		DE93753323	
92-104	18:7395	OSTI; NTIS; INIS		DE93753304	

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92-105	18:7482	OSTI; NTIS; INIS		DE93753322	
92-107	18:7194	OSTI; NTIS; INIS		DE93753305	
92-110	18:6691	OSTI; NTIS; INIS		DE93754291	
92-112	18:6209	OSTI; NTIS; INIS		DE93754295	
92-113	18:5596	OSTI; NTIS; INIS		DE93754292	
92-114	18:5624	OSTI; NTIS; INIS		DE93753349	
92-115	18:7483	OSTI; NTIS; INIS		DE93754297	
92-117	18:5404	OSTI; NTIS; INIS		DE93754296	
92-118	18:5464	OSTI; NTIS; INIS		DE93754309	
92-120	18:7396	OSTI; NTIS; INIS		DE93753398	
92-123	18:5428	OSTI; NTIS; INIS		DE93754310	
92-138	18:6281	OSTI; NTIS; INIS		DE93754330	
92-150	18:5625	OSTI; NTIS; INIS		DE93754367	
JET-R–					
92-03	18:7202	OSTI; NTIS (US Sales Only); INIS		DE93610284	
92-06	18:7203	OSTI; NTIS (US Sales Only); INIS		DE93610250	
JINR-E–					
12-91-28	18:6149	OSTI; NTIS (US Sales Only); INIS		DE93608802	
5-92-23	18:6809	OSTI; NTIS (US Sales Only); INIS		DE93609840	
8-91-67	18:6412	OSTI; NTIS (US Sales Only); INIS		DE93609531	
JINR-R–					
1-91-110	18:6414	OSTI; NTIS (US Sales Only); INIS		DE93609507	
1-91-30	18:6413	OSTI; NTIS (US Sales Only); INIS		DE93609508	
1-91-495	18:7012	OSTI; NTIS (US Sales Only); INIS		DE93610076	
10-90-589	18:7485	OSTI; NTIS (US Sales Only); INIS		DE93609532	
10-91-105	18:7486	OSTI; NTIS (US Sales Only); INIS		DE93609815	
10-91-81	18:6415	OSTI; NTIS (US Sales Only); INIS		DE93609500	
10-91-86	18:6416	OSTI; NTIS (US Sales Only); INIS		DE93609509	
13-90-527	18:6417	OSTI; NTIS (US Sales Only); INIS		DE93609510	
13-91-134	18:6419	OSTI; NTIS (US Sales Only); INIS		DE93609501	
13-91-34	18:6418	OSTI; NTIS (US Sales Only); INIS		DE93609502	
9-91-37	18:7484	OSTI; NTIS (US Sales Only); INIS		DE93609816	
Juel–					
2614	18:6503	OSTI; NTIS (US Sales Only)		DE93744901	
2641	18:5705	OSTI; NTIS (US Sales Only)		DE93744900	
2642	18:5706	OSTI; NTIS (US Sales Only)		DE93744899	
2663	18:6980	OSTI; NTIS (US Sales Only); INIS		DE93744616	
KCP–					
613-4677	18:6248	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004911	PC-706
613-4826	18:6454	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004635	PC-706
613-4865	18:6263	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004912	PC-706
613-4869	18:6264	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004634	PC-706
613-4885	18:6210	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004824	PC-706
613-4967	18:6211	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004823	PC-705
613-4968	18:6265	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004822	PC-706
KEK–					
91-14	18:6339	OSTI; NTIS; INIS		DE93753099	
92-1	18:6420	OSTI; NTIS; INIS		DE93753173	
KEK-PROC–					
92-8	18:6421	OSTI; NTIS; INIS		DE93754138	
KEMI–					
13-91	18:5217	OSTI; NTIS; INIS		DE93609761	
KFK–					
4749	18:6692	OSTI; NTIS (US Sales Only); INIS		DE93750660	
4759	18:6240	OSTI; NTIS (US Sales Only); INIS		DE93750682	
4800f	18:5156	OSTI; NTIS (US Sales Only); INIS		DE93744380	
4996	18:6019	OSTI; NTIS (US Sales Only); INIS		DE93750399	
5019	18:5964	OSTI; NTIS (US Sales Only); INIS		DE93744406	
5028	18:7397	OSTI; NTIS (US Sales Only); INIS		DE93744883	
5051	18:7398	OSTI; NTIS (US Sales Only); INIS		DE93744881	
5055	18:5229	OSTI; NTIS (US Sales Only); INIS		DE93742918	
5070	18:6020	OSTI; NTIS (US Sales Only); INIS		DE93744817	
5072	18:5405	OSTI; NTIS (US Sales Only); INIS		DE93750862	
5073	18:5451	OSTI; NTIS (US Sales Only); INIS		DE93744882	
5076	18:6504	OSTI; NTIS (US Sales Only)		DE93750688	
5087	18:5821	OSTI; NTIS (US Sales Only)		DE93744815	
5089	18:6055	OSTI; NTIS (US Sales Only); INIS		DE93744816	
5093	18:6241	OSTI; NTIS (US Sales Only); INIS		DE93744818	
KFK-PEF–					
80-Vol.2	18:6505	OSTI; NTIS (US Sales Only)		DE93744819	
81	18:6523	OSTI; NTIS (US Sales Only)		DE93750611	

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KFTI–					
90-3	18:6936	OSTI; NTIS (US Sales Only); INIS		DE93609960	
90-4	18:6296	OSTI; NTIS (US Sales Only); INIS		DE93609386	
90-5	18:7147	OSTI; NTIS (US Sales Only); INIS		DE93610443	
90-7	18:7204	OSTI; NTIS (US Sales Only); INIS		DE93610247	
90-8	18:7205	OSTI; NTIS (US Sales Only); INIS		DE93610253	
90-9	18:7206	OSTI; NTIS (US Sales Only); INIS		DE93610263	
90-10	18:6422	OSTI; NTIS (US Sales Only); INIS		DE93609496	
90-11	18:6297	OSTI; NTIS (US Sales Only); INIS		DE93609383	
90-12	18:7013	OSTI; NTIS (US Sales Only); INIS		DE93610074	
90-13	18:6298	OSTI; NTIS (US Sales Only); INIS		DE93609384	
90-14	18:7207	OSTI; NTIS (US Sales Only); INIS		DE93610257	
90-15	18:7208	OSTI; NTIS (US Sales Only); INIS		DE93610258	
90-16	18:7209	OSTI; NTIS (US Sales Only); INIS		DE93610259	
90-17	18:6299	OSTI; NTIS (US Sales Only); INIS		DE93609385	
90-18	18:5965	OSTI; NTIS (US Sales Only); INIS		DE93608977	
90-19	18:7210	OSTI; NTIS (US Sales Only); INIS		DE93610260	
90-20	18:7211	OSTI; NTIS (US Sales Only); INIS		DE93610261	
90-21	18:7212	OSTI; NTIS (US Sales Only); INIS		DE93610262	
KRUPP-VDM-UB–					
12/92	18:5966	OSTI; NTIS (US Sales Only)		DE93742642	
KTM/E-B–					
119	18:5406	OSTI; NTIS; INIS		DE93609469	
121	18:5157	OSTI; NTIS; INIS		DE93609571	
KURRI-TR–					
363	18:6693	OSTI; NTIS; INIS		DE93754137	
KY/YMP-MON–					
1/1992	18:6524	OSTI; NTIS		DE93752938	
LA–					
12356	18:5626	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002708	MF-940
12374-MS	18:5205	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001652	MF-940
12377-MS	18:6839	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002851	MF-900
12390-MS	18:6423	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002623	MF-700
12391	18:6424	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002716	MF-706
12392-MS	18:6021	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003047	
12427-T	18:6840	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004129	MF-910
12429-PR	18:6694	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004287	MF-907
12430-MS	18:5905	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002659	MF-700
12441-MS	18:7014	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004055	MF-413
12468-MS	18:5206	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004788	MF-700
LA-SUB–					
92-10-Pt.1	18:5158	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001290	MF-721
LA-UR–					
88-1937	18:5648	*See* NUREG/CR–5889			
89-2158	18:5646	*See* NUREG/CR–5887			
89-673	18:5647	*See* NUREG/CR–5888			
92-2919	18:6525	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93000798	MF-902
92-2943	18:6795	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000796	MF-403
92-3001	18:7399	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93000684	MF-424
92-3223	18:6425	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003696	MF-910
92-3231	18:6266	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003695	
92-3236	18:7093	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003692	MF-411; MF-404
92-3237	18:7123	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003691	MF-410; MF-404
92-3238	18:6056	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003690	MF-404
92-3241	18:7015	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003689	MF-413
92-3260	18:6150	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003698	MF-910; MF-908
92-3271	18:7094	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003702	MF-406; MF-410
92-3281	18:5967	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003742	
92-3315	18:6841	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003740	
92-3324	18:7400	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003739	MF-426
92-3330	18:6426	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003738	MF-907
92-3334	18:6937	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003737	MF-700
92-3336	18:6842	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003736	MF-910
92-3339	18:7487	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003735	MF-700
92-3363	18:7488	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003734	MF-905; MF-910
92-3371	18:6577	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003731	MF-900

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
92-3385	18:5919	*See* ANL/MSD/CP–77654			
92-3387	18:7489	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003728	MF-705
92-3404	18:7016	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003727	MF-700
92-3406	18:5968	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003726	MF-704
92-3410	18:6652	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003725	MF-905; MF-906
92-3417	18:7017	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003723	MF-413
92-3436	18:6282	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003705	MF-406; MF-414
92-3441	18:6283	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003745	MF-910
92-3466	18:5627	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003743	MF-731
92-3479	18:6878	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003746	MF-910
92-3489	18:6938	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003752	MF-410
92-3490	18:5969	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003751	MF-700
92-3491	18:5970	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003750	MF-700; MF-706
92-3494	18:6340	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003749	MF-406
92-3495	18:7490	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003748	MF-905
92-3496	18:5225	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003747	MF-910; MF-905
92-3499	18:7491	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003784	MF-905
92-3506	18:5226	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003781	MF-706
92-3519	18:6284	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003755	MF-407
92-3541	18:6427	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003791	MF-706
92-3568	18:7492	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003787	MF-405
92-3569	18:6341	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003786	MF-414
92-3581	18:6212	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003809	MF-906
92-3582	18:6300	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003808	MF-414
92-3596	18:6057	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003806	MF-904
92-3600	18:7493	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003804	MF-405
92-3601	18:6428	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003803	MF-906
92-3602	18:6429	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003802	MF-706
92-3603	18:6430	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003801	MF-706
92-3614	18:6939	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003798	MF-412
92-3646	18:6431	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003794	MF-908; MF-906
92-3647	18:6843	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003793	MF-902
92-3649	18:6267	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003812	MF-706
92-3651	18:6695	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003811	MF-940
92-3662	18:6285	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003815	MF-712
92-3664	18:6342	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003814	
92-3682	18:5971	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003816	MF-404
92-3700	18:6696	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003776	MF-907
92-3702	18:6022	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003777	MF-904
92-3710	18:5227	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003778	MF-700
92-3711	18:7401	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003818	MF-706
92-3715	18:5972	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003820	MF-904
92-3719	18:6940	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003821	MF-412
92-3725	18:7494	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003822	MF-905
92-3736	18:6904	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003824	MF-910
92-3752	18:6023	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003826	MF-364
92-3755	18:6058	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003827	MF-213
92-3759	18:7402	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003828	MF-712
92-3761	18:5159	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003829	MF-413
92-3762	18:7018	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003830	MF-413
92-3765	18:7213	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003831	MF-712
92-3774	18:7214	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003834	MF-706
92-3777	18:6213	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003835	MF-406
92-3783	18:5909	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003836	MF-905
92-3785	18:6981	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003837	MF-413
92-3788	18:6941	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003838	MF-410
92-3789	18:6844	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003839	MF-703
92-3797	18:6214	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003840	MF-906
92-3806	18:7019	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003842	MF-413
92-3807	18:6942	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003843	MF-414
92-3808	18:6024	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003844	MF-404
92-3819	18:6845	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003848	
92-3831	18:6059	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003855	MF-904
92-3837	18:6215	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003856	MF-907
92-3845	18:6846	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003857	MF-412
92-3853	18:6831	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003858	MF-406

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
92-3857	18:6943	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003859	MF-910
92-3917	18:6060	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003863	MF-704
92-3935	18:6457	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003864	MF-701
92-3940	18:6111	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003865	MF-906
92-3946	18:6458	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003866	MF-741
92-3956	18:6955	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003867	MF-412
LBL–					
32071	18:6343	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002547	MF-414
32072	18:6344	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002578	MF-414
32152	18:6441	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002542	MF-404
32178	18:6345	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004771	MF-414
32182	18:6286	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004688	MF-406
32220	18:6287	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002569	MF-414
32221	18:6301	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002577	MF-414
32223	18:6288	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002554	MF-414
32232	18:6346	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002576	MF-414
32286	18:6302	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004768	MF-414
32559	18:6373	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004772	MF-414
32635	18:6347	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002447	MF-414
32638	18:5797	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002565	MF-350
32662	18:6619	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001538	
32761	18:6797	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002541	MF-414
32788	18:6348	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002566	MF-414
32809	18:6636	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002556	MF-408
32810	18:5973	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002568	MF-404
32812	18:7020	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002562	MF-414
32818	18:6971	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002553	MF-413
32827	18:5974	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002540	MF-404
32828	18:6025	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002543	MF-404
32831	18:5975	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002558	MF-404
32832	18:7082	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002544	MF-404
32833	18:6061	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002626	MF-404
32871	18:6151	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002555	MF-401
32891	18:7143	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004779	MF-404
32901	18:7124	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002625	MF-404
32920	18:6112	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004783	
32926	18:6191	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002571	MF-400
32927	18:6253	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002572	
32928	18:6192	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002570	MF-401
32938	18:6905	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004707	MF-413
32939	18:6349	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004705	MF-406
32940	18:6350	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004689	MF-413
32950	18:6526	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002574	MF-402
32953	18:6956	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004718	MF-413
32963	18:6289	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004777	MF-413
32978	18:6351	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004693	MF-414
32979	18:7144	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004782	MF-412
32981	18:6352	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004701	MF-404
33020	18:6062	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004708	MF-404
33068	18:6353	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004711	MF-404; MF-411
33092	18:6356	*See* SLAC-PUB–5932			
LBL-PUB–					
5334	18:5730	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002600	MF-400
5341	18:6787	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000589	MF-407
5350	18:6578	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000586	MF-402
5351	18:6527	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000585	MF-402
5352	18:5160	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002592	MF-402
5353	18:5161	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002583	MF-402
5354	18:5162	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002584	MF-402
5356	18:5163	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002590	MF-402
LEM–					
92-04	18:5285	OSTI; NTIS		DE93743642	
LIS–					
98	18:5381	OSTI; NTIS (US Sales Only)		DE93742644	
LITH-MAT-R–					
92-32	18:6620	OSTI; NTIS		DE93753076	
LUIP–					
9202.	18:7021	*See* LUNFD6-NFFK–7131/1992			
9203.	18:7022	*See* LUNFD6-NFFK–7132/1992			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
LUMEDW-MEMA–					
1038-1-100-1992	18:6648	OSTI; NTIS; INIS		DE93609306	
LUMEDW-MEOK–					
1015/1992	18:6649	OSTI; NTIS; INIS		DE93609315	
LUNFD6-NFFK–					
7131/1992	18:7021	OSTI; NTIS; INIS		DE93610093	
7132/1992	18:7022	OSTI; NTIS; INIS		DE93610094	
LUTFD2-TFKF–					
3061/1990	18:6579	OSTI; NTIS; INIS		DE93609070	
3062/1990	18:6580	OSTI; NTIS; INIS		DE93609071	
3063/1990	18:6581	OSTI; NTIS; INIS		DE93609072	
LUTVDG/TVBM–					
1011-1-132-1992	18:6063	OSTI; NTIS; INIS		DE93609044	
LW–					
1992-1	18:6113	OSTI; NTIS (US Sales Only)		DE93750596	
MITNRL–					
049	18:5472	*See* DOE/ER/12930–1			
MLM–					
3766	18:5822	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002948	MF-700
MPI-PhE–					
92-03	18:6944	OSTI; NTIS (US Sales Only); INIS		DE93744563	
MST-LUFT-A–					
122-Ed.2	18:6529	OSTI; NTIS		DE93752791	
96-Ed.2	18:6528	OSTI; NTIS		DE93752747	
N–					
6-92-R194	18:5627	*See* LA-UR–92-3466			
6-92-R197	18:6284	*See* LA-UR–92-3519			
6-92-R208	18:6695	*See* LA-UR–92-3651			
NASA/CR–					
189228	18:5863	*See* DOE/NASA/0335–4			
190772	18:6049	*See* DOE/NASA/0030–9			
NEFF–					
349/FN-2.331-0.86-Syn.	18:5798	OSTI; NTIS (US Sales Only); NEFF Secretariat, P.O. Box 1564, CH-4001 Basel, Switzerland		DE90513606	
NEI-DK–					
1000	18:5850	OSTI; NTIS		DE93752813	
1001	18:5295	OSTI; NTIS		DE93752812	
1003	18:5325	OSTI; NTIS		DE93752810	
1005	18:5249	OSTI; NTIS		DE93752806	
1006	18:5711	OSTI; NTIS		DE93752805	
1007	18:6582	OSTI; NTIS		DE93752823	
1008	18:5851	OSTI; NTIS		DE93752820	
1010	18:6583	OSTI; NTIS		DE93752803	
1013	18:5712	OSTI; NTIS		DE93752819	
1014	18:6780	OSTI; NTIS		DE93752811	
1016	18:5003	OSTI; NTIS		DE93752790	
1018	18:5326	OSTI; NTIS		DE93752793	
1020	18:5758	OSTI; NTIS; INIS		DE93752794	
1021	18:5244	OSTI; NTIS		DE93752799	
1022	18:6584	OSTI; NTIS		DE93752798	
1023	18:5731	OSTI; NTIS		DE93752797	
1025	18:5687	OSTI; NTIS		DE93752752	
1026	18:6585	OSTI; NTIS		DE93752974	
1027	18:5740	OSTI; NTIS		DE93752975	
1028	18:5823	OSTI; NTIS		DE93752977	
1029	18:5254	OSTI; NTIS		DE93752979	
1030	18:5250	OSTI; NTIS		DE93752978	
1032	18:5253	OSTI; NTIS; INIS		DE93752976	
980	18:5318	OSTI; NTIS; INIS		DE93752754	
981	18:4958	OSTI; NTIS		DE93752783	
988	18:5686	OSTI; NTIS		DE93752759	
989	18:5707	OSTI; NTIS		DE93752781	
993	18:5294	OSTI; NTIS		DE93752804	
994	18:5323	OSTI; NTIS		DE93752755	
995	18:5324	OSTI; NTIS		DE93752758	
999	18:5849	OSTI; NTIS		DE93752814	
NEI-FI–					
175	18:5351	OSTI; NTIS		DE93752936	
176	18:5380	OSTI; NTIS; INIS		DE93752937	
NEI-NO–					
293	18:4969	OSTI; NTIS		DE93752946	

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
299	18:5742	OSTI; NTIS		DE93752968	
300	18:5887	OSTI; NTIS		DE93752997	
301	18:5261	OSTI; NTIS		DE93752998	
302	18:6258	OSTI; NTIS		DE93752999	
303	18:4974	OSTI; NTIS		DE93753000	
304	18:4975	OSTI; NTIS		DE93753012	
NEI-SE–					
97	18:5732	OSTI; NTIS		DE93753068	
NESC–					
1094	18:7466	*See* ESTSC/NRC–000075C017000			
1094	18:7467	*See* ESTSC/NRC–000075I303300			
1094	18:7468	*See* ESTSC/NRC–000075IBMPC00			
1100	18:7476	*See* ESTSC/NRC/R–000150I303X00			
1109	18:7474	*See* ESTSC/NRC/R–000147I303300			
1112	18:7473	*See* ESTSC/NRC/R–000146I303300			
1114	18:7471	*See* ESTSC/NRC/R–000143CYYMP00			
1114	18:7472	*See* ESTSC/NRC/R–000143I309000			
1116	18:7475	*See* ESTSC/NRC/R–000148I036000			
338	18:7464	*See* ESTSC–000549I036000			
482	18:7460	*See* ESTSC–000472I036000			
836	18:7469	*See* ESTSC/NRC/R–000126C760000			
836	18:7470	*See* ESTSC/NRC/R–000126CY00100			
9508	18:7465	*See* ESTSC–000550IBMPC00			
9564	18:7455	*See* ESTSC–000321IPCAT00			
IAEA0873	18:7463	*See* ESTSC–000506C017000			
IAEA0920	18:7462	*See* ESTSC–000505I308100			
NEA0090	18:7461	*See* ESTSC–000504C360000			
NIFS–					
127	18:7215	OSTI; NTIS; INIS		DE93753084	
128	18:7403	OSTI; NTIS; INIS		DE93753083	
129	18:7216	OSTI; NTIS; INIS		DE93753085	
130	18:7217	OSTI; NTIS; INIS		DE93753087	
131	18:7218	OSTI; NTIS; INIS		DE93753086	
133	18:7219	OSTI; NTIS; INIS		DE93753306	
134	18:7220	OSTI; NTIS; INIS		DE93753307	
135	18:7221	OSTI; NTIS; INIS		DE93753308	
136	18:7222	OSTI; NTIS; INIS		DE93753309	
137	18:7223	OSTI; NTIS; INIS		DE93753310	
139	18:7224	OSTI; NTIS; INIS		DE93753311	
141	18:7225	OSTI; NTIS; INIS		DE93753312	
142	18:7226	OSTI; NTIS; INIS		DE93753313	
143	18:7227	OSTI; NTIS; INIS		DE93753194	
144	18:7404	OSTI; NTIS; INIS		DE93753195	
145	18:7228	OSTI; NTIS; INIS		DE93753196	
146	18:7229	OSTI; NTIS; INIS		DE93753197	
147	18:7230	OSTI; NTIS; INIS		DE93753198	
148	18:7231	OSTI; NTIS; INIS		DE93753199	
149	18:7405	OSTI; NTIS; INIS		DE93753200	
150	18:7232	OSTI; NTIS; INIS		DE93753201	
151	18:7406	OSTI; NTIS; INIS		DE93753202	
152	18:7407	OSTI; NTIS; INIS		DE93753203	
153	18:7233	OSTI; NTIS; INIS		DE93753314	
154	18:7234	OSTI; NTIS; INIS		DE93753315	
160	18:7408	OSTI; NTIS; INIS		DE93754331	
162	18:7235	OSTI; NTIS; INIS		DE93754332	
164	18:7236	OSTI; NTIS; INIS		DE93754333	
166	18:7237	OSTI; NTIS; INIS		DE93754334	
NIFS-DATA–					
15	18:7023	OSTI; NTIS; INIS		DE93753246	
16	18:7238	OSTI; NTIS; INIS		DE93753240	
NIFS-MEMO–					
3	18:7409	OSTI; NTIS; INIS		DE93753276	
6	18:7410	OSTI; NTIS; INIS		DE93753316	
NILU-OR–					
20/92	18:5715	OSTI; NTIS		DE93753003	
32/92	18:6530	OSTI; NTIS		DE93753001	
7/92	18:5714	OSTI; NTIS; INIS		DE93753017	
73/91	18:6531	OSTI; NTIS		DE93753016	
74/91	18:6532	OSTI; NTIS		DE93753002	
NIPER–					
598	18:6152	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000102	PC-125

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NIPER–					
611	18:4980	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000103	PC-122
623	18:6153	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000104	PC-122
629	18:4981	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000105	PC-122
630	18:4982	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004304	MF-122
632	18:4983	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000106	PC-122
NREL/CP–					
412-5007	18:5910	OSTI; NTIS; GPO Dep.	E 1.99:	DE92016446	MF-233; MF-270
413-5064	18:5272	OSTI; NTIS; GPO Dep.	E 1.99:	DE92016424	MF-270
NREL/TP–					
254-4147	18:5799	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000013	MF-231
257-4655	18:5327	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000012	MF-261
411-5125	18:5273	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93000019	MF-270
411-5165	18:7495	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000034	MF-270
421/4978	18:5245	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000043	MF-241
432-5182	18:5800	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000046	MF-231
463-4952	18:5892	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000038	MF-331
NSS/R–					
279	18:5164	OSTI; NTIS (US Sales Only); INIS		DE93609572	
NUREG–					
0090-Vol.15-No.2	18:5628	OSTI; NTIS; INIS; GPO		TI93003261	
0304-Vol.17-No.2	18:5434	OSTI; NTIS; INIS; GPO		TI93001391	
0304-Vol.17-No.3	18:5435	OSTI; NTIS; INIS; GPO		TI93004792	
0383-Vol.1-Rev.15	18:5114	OSTI; NTIS; INIS; GPO		TI93003257	
0383-Vol.2-Rev.15	18:5115	OSTI; NTIS; INIS; GPO		TI93003258	
0386-Digest-6-Rev.4	18:5436	OSTI; NTIS; INIS; GPO		TI93004059	
0540-Vol.14-No.8	18:5437	OSTI; NTIS; INIS; GPO		TI93003164	
0540-Vol.14-No.9	18:5438	OSTI; NTIS; INIS; GPO		TI93004056	
0847-Suppl.10	18:5629	OSTI; NTIS; INIS; GPO		TI93002527	
0936-Vol.11-No.3	18:5439	OSTI; NTIS; INIS; GPO		TI93003480	
1303-Rev.2	18:5440	OSTI; NTIS; GPO		TI93003770	
1430-Vol.2	18:5407	OSTI; NTIS; INIS; GPO		TI93002202	
1430-Vol.3	18:5408	OSTI; NTIS; INIS; GPO		TI93002203	
1431-Vol.2	18:5482	OSTI; NTIS; INIS; GPO		TI93002728	
1431-Vol.3	18:5409	OSTI; NTIS; INIS; GPO		TI93002729	
1432-Vol.1	18:5410	OSTI; NTIS; INIS; GPO		TI93003056	
1433-Vol.3	18:5387	OSTI; NTIS; INIS; GPO		TI93002534	
1434-Vol.1	18:5388	OSTI; NTIS; INIS; GPO		TI93003059	
1434-Vol.2	18:5389	OSTI; NTIS; INIS; GPO		TI93003060	
NUREG/BR–					
0171-Vol.1	18:5630	OSTI; NTIS; INIS; GPO		TI93003636	
NUREG/CP–					
0125	18:5633	OSTI; NTIS; INIS; GPO		TI93001402	
NUREG/CR–					
4012-Vol.3	18:5441	OSTI; NTIS; INIS; GPO		TI93002601	
4832-Vol.10	18:5635	OSTI; NTIS; INIS; GPO		TI93002817	
4832-Vol.4	18:5634	OSTI; NTIS; INIS; GPO		TI93002698	
4918-Vol.6	18:5165	OSTI; NTIS; INIS; GPO		TI93003477	
5379-Vol.2	18:5636	OSTI; NTIS; INIS; GPO		TI93003172	
5790	18:5637	OSTI; NTIS; INIS; GPO		TI93001398	
5793	18:5460	OSTI; NTIS; INIS; GPO		TI93001343	
5813-Vol.2	18:5638	OSTI; NTIS; INIS		TI93003140	
5816	18:5639	OSTI; NTIS; INIS; GPO		TI93002816	
5823	18:5640	OSTI; NTIS; INIS; GPO		TI93003214	
5827	18:5641	OSTI; NTIS; INIS; GPO		TI93001563	
5831	18:5642	OSTI; NTIS; INIS; GPO		TI93003050	
5832	18:5643	OSTI; NTIS; INIS; GPO		TI93003049	
5839	18:5644	OSTI; NTIS; INIS; GPO		TI93001866	
5869	18:5645	OSTI; NTIS; INIS; GPO		TI93003210	
5887	18:5646	OSTI; NTIS; INIS; GPO		TI93003212	
5888	18:5647	OSTI; NTIS; INIS; GPO		TI93003211	
5889	18:5648	OSTI; NTIS; INIS; GPO		TI93003213	
5900-Vol.1-No.1	18:5649	OSTI; NTIS; INIS; GPO		TI93003326	
5913-Vol.2	18:5461	OSTI; NTIS; INIS; GPO		TI93003218	
5915	18:5462	OSTI; NTIS; INIS; GPO		TI93003171	
5924	18:5650	OSTI; NTIS; INIS; GPO		TI93002198	
5925-Vol.1	18:5651	OSTI; NTIS; INIS; GPO		TI93002315	
NUREG/GR–					
0004	18:5976	OSTI; NTIS; INIS; GPO		TI93004058	
NUTEK-ALTD–					
92-4	18:4971	OSTI; NTIS		DE93753019	

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NUTEK-B–					
92-9	18:5738	OSTI; NTIS		DE93753071	
NUTEK-FBT–					
92-12	18:5004	OSTI; NTIS		DE93753021	
92-13	18:5251	OSTI; NTIS		DE93753020	
NUTEK-FJV–					
92-2	18:5852	OSTI; NTIS		DE93753018	
NUTEK-R–					
92-25	18:5688	OSTI; NTIS		DE93753059	
NUTEK-TB–					
92-8	18:5255	OSTI; NTIS		DE93753078	
NUTEK-VIND–					
92-9	18:5328	OSTI; NTIS		DE93753079	
NYU-TR–					
92/09/04	18:6893	*See* DESY–92-102			
OCS/MMS–					
92-0059	18:5002	OSTI; INIS; US Department of the Interior, Minerals Management Service, MS-4610, 381 Elden Street, Herndon, VA 22070-4817		TI93003569	
OFR–					
41	18:6615	*See* DOE/SR/15160–5			
ORAU–					
92/F8	18:6784	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93005675	MF-408; MF-407
92/F9	18:6785	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93005674	MF-408; MF-407
ORNL-CCIP–					
92-14	18:6920	*See* CONF-9209279–1			
ORNL/CON–					
308	18:5801	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003591	MF-350
309	18:5802	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002622	MF-202
317	18:5803	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003668	MF-350
ORNL/ER–					
135	18:5166	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001787	MF-902
139	18:6621	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93000719	MF-902
141	18:5194	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001423	MF-902
62/R1	18:6781	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000549	MF-902
85	18:5193	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93000977	MF-902
ORNL/ER/Sub–					
91-KA931/4	18:6586	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001420	MF-902
ORNL/FMP–					
92/2	18:5911	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004433	MF-114
ORNL/M–					
1741	18:6114	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003592	MF-332
1929/R3	18:5716	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002620	MF-630
1929/R4	18:5717	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003677	MF-630
2253	18:5888	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003640	MF-332
2347/V1	18:5376	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003683	MF-902
2347/V2-Pt.1	18:5377	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003682	MF-902
2347/V2-Pt.2	18:5378	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003681	MF-902
2377	18:5167	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003111	MF-523
2524	18:5137	*See* DOE/RW–0006-Rev.8			
ORNL/RASA–					
92/12	18:6587	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003672	MF-902
92/5	18:5090	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003758	MF-902
92/7	18:5061	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003760	MF-902
92/8	18:5062	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003761	MF-902
92/9	18:5063	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003762	MF-902
ORNL/SUB–					
88-07685/03	18:5977	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004064	MF-114
ORNL/Sub–					
87-00184/03	18:6064	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004063	MF-114
ORNL/TM–					
11969	18:5460	*See* NUREG/CR–5793			
12047	18:7411	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003664	PC-424
12056	18:6216	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003676	
12080	18:5645	*See* NUREG/CR–5869			
12136/V1-No.1	18:5649	*See* NUREG/CR–5900-Vol.1-No.1			
12156/V2	18:5461	*See* NUREG/CR–5913-Vol.2			
12166	18:5462	*See* NUREG/CR–5915			
12172	18:7496	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004276	

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ORNL/TM–					
12204	18:7497	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003365	MF-405
12232	18:5195	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003585	MF-507
12239	18:5168	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003641	MF-810
OY/PSTL-TIED–					
83	18:4911	OSTI; NTIS		DE93752921	
OZ–					
91/12.	18:6907	*See* UM-P–91/86			
91/20.	18:6881	*See* UM-P–91/93			
91/21.	18:6882	*See* UM-P–91/108			
91/22.	18:6949	*See* UM-P–91/112			
92/01.	18:6908	*See* UM-P–92/01			
92/04.	18:6910	*See* UM-P–92/08			
92/09.	18:6911	*See* UM-P–92/18			
92/13.	18:6814	*See* UM-P–92/43			
92/18.	18:6815	*See* UM-P–92/46			
OZ-P–					
92/02.	18:6812	*See* UM-P–91/103			
92/03.	18:6883	*See* UM-P–92/04			
92/04.	18:6975	*See* UM-P–92/07			
PFC/RR–					
92-11	18:6217	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002332	
92-13	18:7239	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002333	MF-420
PNC-TN–					
8410-91-274	18:5169	OSTI; NTIS; INIS		DE93754142	
PNL–					
7605	18:5644	*See* NUREG/CR–5839			
7726	18:5641	*See* NUREG/CR–5827			
7782	18:5643	*See* NUREG/CR–5832			
7783	18:5642	*See* NUREG/CR–5831			
7843	18:5597	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003982	MF-1000
7916-Vol.2	18:5636	*See* NUREG/CR–5379-Vol.2			
8218	18:5824	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004631	MF-310
8278	18:5170	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002357	MF-940
8333	18:5196	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002182	MF-902
8413	18:5197	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005603	MF-607
8416	18:6788	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005604	MF-607
8417	18:6789	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005596	MF-600
8418	18:6790	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005605	MF-607
8419	18:5198	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004482	MF-600
8420	18:6791	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005597	MF-600
8455	18:6218	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005598	MF-900
PNL-SA–					
20706	18:7498	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004402	MF-600
20868	18:5199	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001312	MF-902
21185	18:5736	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004333	MF-350
21253	18:7429	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001561	MF-902
21302	18:7070	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004324	MF-411
21322	18:5652	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001555	
21443	18:4896	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004326	MF-108
PNWD–					
1980-05-HEDR	18:6697	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003209	MF-707
2028-HEDR	18:6698	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000842	MF-707
2047-HEDR	18:6699	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003216	
POEF-T–					
3604	18:5065	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002262	MF-506
POEF/ER–					
4548	18:5200	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003320	MF-902
PPPL–					
2871	18:7412	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93005729	PC-426; PC-427
PRE–					
1292.	18:7186	*See* INPE–4546			
1296.	18:7187	*See* INPE–4550			
1683.	18:7189	*See* INPE–5259			
1748.	18:7190	*See* INPE–5375			
644.	18:7188	*See* INPE–5228			
PRP–					
163.	18:6837	*See* INPE–5359			
PSC–					
17	18:7240	OSTI; NTIS; INIS		DE93753241	

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18	18:7241	OSTI; NTIS; INIS		DE93753242	
19	18:7242	OSTI; NTIS; INIS		DE93753244	
20	18:7413	OSTI; NTIS; INIS		DE93753243	
21	18:7243	OSTI; NTIS; INIS		DE93753317	
23	18:7244	OSTI; NTIS; INIS		DE93754311	
PSI–					
122	18:6700	OSTI; NTIS; INIS		DE93609232	
PTB-N–					
8	18:7024	OSTI; NTIS (US Sales Only); INIS		DE93742733	
PUC-RT–					
104/89	18:5218	OSTI; NTIS (US Sales Only); INIS		DE93609325	
PWR/TUG/P–					
91-119.	18:6228	*See* AEA-RS–1066			
RA–					
160.	18:6618	*See* INPE–2361			
RAL–					
92-038	18:7025	OSTI; NTIS (US Sales Only); INIS		DE93610095	
92-044	18:7048	OSTI; NTIS (US Sales Only); INIS		DE93610132	
92-045	18:7049	OSTI; NTIS (US Sales Only); INIS		DE93610133	
RAMA-III–					
89-04	18:5488	OSTI; NTIS; INIS		DE93609206	
RCNP-P–					
120	18:7026	OSTI; NTIS; INIS		DE93752300	
121	18:7430	OSTI; NTIS; INIS		DE93753382	
RF–					
4/91	18:4984	OSTI; NTIS		DE93752941	
5/91	18:4985	OSTI; NTIS		DE93752942	
RFP–					
4610	18:5978	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE92018618	MF-701
4628	18:6185	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002257	MF-701
4645	18:5201	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002261	MF-706; MF-702
4667	18:5889	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004210	MF-706
4673	18:6449	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004212	MF-706
RISO-M–					
2941	18:5741	OSTI; NTIS		DE93752750	
RISO-R–					
604	18:5733	OSTI; NTIS		DE93752744	
606	18:5329	OSTI; NTIS		DE93752741	
613	18:4966	OSTI; NTIS		DE93752740	
617	18:5330	OSTI; NTIS		DE93752751	
630	18:5331	OSTI; NTIS		DE93752742	
631	18:5894	OSTI; NTIS		DE93752743	
RL-SEP–					
282	18:5091	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002449	MF-500
405-Del.	18:5092	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003971	MF-500
509-Del.	18:5103	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003972	MF-500
654-Del.	18:5104	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003973	MF-500
706-Del.	18:5105	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003974	MF-510
755-Del.	18:5106	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003975	MF-510
874-Del.	18:5107	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003976	MF-500
913-Del.	18:5108	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003977	MF-500
SA-PUB–					
3/92	18:5718	OSTI; NTIS		DE93752870	
SAIC–					
87-029	18:5640	*See* NUREG/CR–5823			
92/6668-R1-Vol.1	18:5651	*See* NUREG/CR–5925-Vol.1			
SAND–					
90-1983	18:5171	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001404	MF-940; MF-905
90-2406	18:6219	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004596	PC-820
91-1535	18:5637	*See* NUREG/CR–5790			
91-2174C	18:7083	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004069	MF-405
91-2396C	18:6847	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002474	MF-402
91-2816C	18:6249	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002467	MF-706
91-2891C	18:6065	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002306	MF-114
91-2892C	18:6066	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003247	MF-704
91-7012	18:5332	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004480	MF-261
92-0300C	18:5306	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003244	MF-236
92-0369	18:5734	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93005042	PC-900
92-0400C	18:5979	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004067	MF-704

SAND–

Report Number	*Abstract Number*	*Source of Availability*	*GPO Dep.*	*Order Number*	*Distribution Category*
92-0484	18:6026	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003233	MF-704
92-0537	18:5635	*See* NUREG/CR–4832-Vol.10			
92-0537-Vol.4	18:5634	*See* NUREG/CR–4832-Vol.4			
92-0604C	18:5307	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002298	MF-270
92-0658C	18:5274	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002483	MF-271
92-0765C	18:6455	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003249	MF-700
92-0817C	18:5202	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93000741	MF-902
92-0885	18:6242	OSTI; NTIS; GPO Dep.	E 1.99:	DE93006451	MF-705
92-0889C	18:5980	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002283	MF-704; MF-706
92-0914C	18:6027	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002488	MF-704
92-0921C	18:5981	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002280	MF-704
92-1162C	18:5333	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003252	MF-261
92-1295	18:7499	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004274	MF-705
92-1350C	18:5429	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002301	MF-743
92-1373C	18:5653	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002485	
92-1374	18:6067	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002595	MF-704
92-1429C	18:6220	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002461	MF-704
92-1535	18:6450	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005380	MF-906
92-1594C	18:7095	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002489	MF-700
92-1665C	18:5334	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003253	MF-261
92-1707C	18:6848	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93004045	MF-706
92-1723C	18:5654	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002297	MF-523
92-1750C	18:5655	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002473	
92-1825C	18:5275	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002486	MF-270
92-1835C	18:5676	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002476	MF-700
92-1843C	18:7027	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002484	MF-700
92-1880C	18:6463	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003243	MF-705
92-1903C	18:7511	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002281	MF-902; MF-905
92-1906C	18:6268	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000743	MF-706
92-1939C	18:4907	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004066	MF-706; MF-702
92-1975C	18:6221	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002287	MF-406
92-2009C	18:5430	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002468	MF-743
92-2041C	18:5982	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002165	MF-704
92-2073C	18:6269	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93000715	MF-700
92-2079C	18:6115	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002482	MF-701
92-2104C	18:6456	OSTI; NTIS; GPO Dep.	E 1.99:	DE93000716	MF-705
92-2123C	18:5288	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003251	MF-237
92-2126C	18:6459	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002303	MF-741
92-2151C	18:6222	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002285	MF-700
92-2177C	18:6068	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002469	MF-704
92-2189C	18:5296	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002286	MF-234
92-2242C	18:5656	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002457	
92-2264C	18:5657	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002477	
92-2298C	18:5983	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003250	MF-404
92-2342C	18:5658	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002460	MF-744
92-2355C	18:6250	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003999	MF-706
92-2375C	18:5023	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004052	MF-742
92-2408C	18:5984	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003994	MF-704
92-2410C	18:6650	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003995	MF-708
92-2417C	18:5335	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004049	MF-261
92-2430	18:5825	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004279	PC-900
92-2434C	18:6270	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004042	MF-904
92-2445C	18:7431	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004051	MF-700
92-7005	18:6069	OSTI; NTIS; GPO Dep.	E 1.99:	DE93005381	MF-261
92-7295C	18:5431	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93003239	MF-706
92-8524	18:6651	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002671	MF-401
92-8629C	18:7074	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002672	MF-411
93-8201	18:5826	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004384	MF-902
93-8401C	18:7075	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002673	MF-411
93-8402C	18:6193	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003906	MF-411
SCH–					
90030847	18:5694	*See* DOE/EIS–0157			
90030847	18:6470	*See* DOE/EIS–0157-Exec.Summ.			
90030847	18:6562	*See* DOE/EIS–0157-Vol.1			
90030847	18:6563	*See* DOE/EIS–0157 Vol.2			
90030847	18:6564	*See* DOE/EIS–0157-Vol.3			
90030847	18:6565	*See* DOE/EIS–0157-Vol.4			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
SCIPP–					
92/44	18:6946	*See* SLAC-PUB–5969			
SDC–					
92-350	18:6378	*See* ANL-HEP-TR–92-97			
SGI-VARIA–					
371	18:5852	*See* NUTEK-FJV–92-2			
SI–					
910125-3	18:4976	OSTI; NTIS		DE93752945	
SISSA–					
139/92/FM	18:6862	*See* DESY–92-118			
SLAC-PUB–					
5852	18:6373	*See* LBL–32559			
5888	18:6354	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004002	MF-414
5913	18:7500	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004003	MF-414
5921	18:7501	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004004	MF-414
5922	18:7502	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004005	MF-414
5923	18:7503	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004006	MF-414
5925	18:6432	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004007	MF-414
5926	18:6945	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004008	MF-414
5929	18:6355	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004009	MF-414
5930	18:7513	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004010	MF-414
5932	18:6356	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004011	MF-414
5936	18:6374	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004012	MF-414
5937	18:6957	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004013	MF-414
5945	18:6433	OSTI; NTIS; INIS; GPO; GPO Dep.	E 1.99:	DE93004014	MF-414
5946	18:6434	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004015	MF-414
5953	18:6435	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004017	MF-414
5958	18:6958	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004271	MF-414
5969	18:6946	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004019	MF-414
5973	18:6947	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004020	MF-414
5987	18:6357	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004273	MF-414
5997	18:6948	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004272	MF-414
5999	18:6906	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004629	MF-414
6002	18:6959	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004628	MF-414
SLU-LT-R–					
155	18:5827	OSTI; NTIS		DE93753073	
SLU-ST-UPPRLT–					
222	18:5234	OSTI; NTIS		DE93753072	
SLU-VKL-R–					
230	18:5255	*See* NUTEK-TB–92-8			
SNV–					
3980	18:5719	OSTI; NTIS		DE93753040	
3981	18:5720	OSTI; NTIS		DE93753041	
4006	18:5721	OSTI; NTIS		DE93753042	
SOL–					
92-4	18:7504	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002528	MF-405
SR/H–					
218	18:5421	*See* DPW–5365			
229	18:5474	*See* DPW–5430			
244	18:5494	*See* DPW–53-7-4			
245	18:5495	*See* DPW–53-614			
258	18:5142	*See* DPW–53-661			
259	18:5614	*See* DPW–53-676			
260	18:5613	*See* DPW–53-675			
268	18:6672	*See* DPW–53-129			
SRO–					
819-21	18:6590	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004451	MF-402
SSCL–					
499.	18:6879	*See* UM-P–91/61			
521	18:6358	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004391	PC-414
585	18:6359	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004393	PC-414
586	18:6360	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004389	PC-414
593	18:6361	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004392	PC-414
SSCL-Preprint–					
147	18:6362	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93000836	MF-414
158	18:6290	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003262	MF-414
161	18:6303	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003367	MF-414
164	18:6436	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002778	MF-414
175	18:6363	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004458	MF-414
SSCL-SR–					
1216	18:6291	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004394	PC-400

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STUDSVIK-M–					
92-14	18:6630	*See* SVF–434			
STUDSVIK-UD–					
91-23	18:6071	*See* SVF–450			
STUK-A–					
101	18:6437	OSTI; NTIS; INIS		DE93609497	
STUVA–					
27/91	18:6070	OSTI; NTIS (US Sales Only)		DE93750626	
SVF–					
427	18:6550	OSTI; NTIS		DE93753065	
434	18:6630	OSTI; NTIS		DE93753063	
440	18:5252	OSTI; NTIS		DE93753064	
441	18:5246	OSTI; NTIS		DE93753060	
444	18:6551	OSTI; NTIS		DE93753061	
445	18:5852	*See* NUTEK-FJV–92-2			
450	18:6071	OSTI; NTIS		DE93753062	
TKK-KO/ET–					
44	18:5828	OSTI; NTIS		DE93752935	
TKK-S/SM–					
1989/21	18:5748	OSTI; NTIS		DE93711132	
TR–					
4504-017-92	18:5838	*See* DOE/CE/26603–T2			
TRITA-KRV–					
91-5	18:5004	*See* NUTEK-FBT–92-12			
TTC–					
1019	18:6219	*See* SAND–90-2406			
TVA-Bull–					
Y-211	18:6659	*See* TVA/NFDC–90/2			
Y-212	18:6660	*See* TVA/NFDC–90/4			
Y-216	18:6661	*See* TVA/NFERC–90/9			
Y-217	18:6154	*See* TVA/NFERC–91/4			
Y-220	18:6662	*See* TVA/NFERC–91/7			
Y-221	18:6663	*See* TVA/NFERC–91/8			
Y-225	18:6664	*See* TVA/NFERC–91/15			
Z-292	18:6591	*See* TVA/NFERC–91/5			
Z-297	18:5829	OSTI; NTIS		DE93002451	
Z-298	18:5986	OSTI; NTIS		DE93002581	
Z-299	18:5987	OSTI; NTIS		DE93002455	
Z-300	18:5988	OSTI; NTIS		DE93002453	
Z-301	18:5297	OSTI; NTIS		DE93002454	
Z-304	18:5830	OSTI; NTIS		DE93002589	
Z-307	18:6224	OSTI; NTIS		DE93002588	
Z-317	18:6072	OSTI; NTIS		DE93003907	
Z-319	18:6073	OSTI; NTIS		DE93003909	
Z-322	18:5831	OSTI; NTIS		DE93003912	
Z-324	18:4897	OSTI; NTIS		DE93003914	
TVA/NFDC–					
90/2	18:6659	OSTI; NTIS		DE93003904	
90/4	18:6660	OSTI; NTIS		DE93003905	
TVA/NFERC–					
90/9	18:6661	OSTI; NTIS		DE93003915	
91/15	18:6664	OSTI; NTIS		DE93003921	
91/4	18:6154	OSTI; NTIS		DE93003931	
91/5	18:6591	OSTI; NTIS		DE93003929	
91/7	18:6662	OSTI; NTIS		DE93003873	
91/8	18:6663	OSTI; NTIS		DE93003872	
TYOT-MON–					
3/1991	18:5804	OSTI; NTIS		DE93752933	
4/1991	18:5805	OSTI; NTIS		DE93752934	
UCRL–					
53859-91	18:5022	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93004914	PC-104; PC-109; PC-117; PC-121;
UCRL-JC–					
105642-Rev.1	18:6849	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003469	MF-700
108124	18:6271	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001328	MF-704; MF-712
108962	18:6451	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002888	MF-700
109895	18:7245	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002876	MF-421

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
110144	18:6850	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002891	MF-700
110770	18:6301	*See* LBL–32221			
110847	18:6364	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001619	MF-706
111197	18:6365	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002889	MF-700
111252	18:6851	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003468	MF-700
111254	18:6852	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003466	MF-700
111311	18:7432	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001302	MF-800
111380	18:6373	*See* LBL–32559			
111467	18:7071	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003478	MF-700
111508	18:6853	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002885	MF-700
111893	18:7246	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002893	MF-700
111939	18:6972	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003467	MF-700
112024	18:6081	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002887	MF-404
112124	18:6082	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003136	MF-701
UCRL-LR–					
105821-2	18:7414	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004825	PC-712
111710	18:7076	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002895	MF-700
111863	18:7247	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002890	MF-426
UJV–					
9581-CH	18:6119	OSTI; NTIS (US Sales Only); INIS		DE93608794	
UM-P–					
91/102	18:6974	OSTI; NTIS (US Sales Only); INIS		DE93610036	
91/103	18:6812	OSTI; NTIS (US Sales Only); INIS		DE93609841	
91/108	18:6882	OSTI; NTIS (US Sales Only); INIS		DE93609919	
91/109	18:6982	OSTI; NTIS (US Sales Only); INIS		DE93610047	
91/111	18:7514	OSTI; NTIS (US Sales Only); INIS		DE93609809	
91/112	18:6949	OSTI; NTIS (US Sales Only); INIS		DE93609963	
91/26	18:6810	OSTI; NTIS (US Sales Only); INIS		DE93609842	
91/39	18:6811	OSTI; NTIS (US Sales Only); INIS		DE93609843	
91/44	18:6438	OSTI; NTIS (US Sales Only); INIS		DE93609517	
91/50	18:6366	OSTI; NTIS (US Sales Only); INIS		DE93609404	
91/61	18:6879	OSTI; NTIS (US Sales Only); INIS		DE93609879	
91/70	18:6880	OSTI; NTIS (US Sales Only); INIS		DE93609880	
91/86	18:6907	OSTI; NTIS (US Sales Only); INIS		DE93609933	
91/91	18:6304	OSTI; NTIS (US Sales Only); INIS		DE93609387	
91/93	18:6881	OSTI; NTIS (US Sales Only); INIS		DE93609920	
91/94	18:6973	OSTI; NTIS (US Sales Only); INIS		DE93610037	
91/97	18:6367	OSTI; NTIS (US Sales Only); INIS		DE93609405	
91/98	18:7050	OSTI; NTIS (US Sales Only); INIS		DE93610134	
92/01	18:6908	OSTI; NTIS (US Sales Only); INIS		DE93609953	
92/02	18:6909	OSTI; NTIS (US Sales Only); INIS		DE93609927	
92/03	18:6813	OSTI; NTIS (US Sales Only); INIS		DE93609844	
92/04	18:6883	OSTI; NTIS (US Sales Only); INIS		DE93609921	
92/06	18:6083	OSTI; NTIS (US Sales Only); INIS		DE93609039	
92/07	18:6975	OSTI; NTIS (US Sales Only); INIS		DE93609994	
92/08	18:6910	OSTI; NTIS (US Sales Only); INIS		DE93609928	
92/11	18:6976	OSTI; NTIS (US Sales Only); INIS		DE93610038	
92/12	18:7072	OSTI; NTIS (US Sales Only); INIS		DE93610181	
92/15	18:7096	OSTI; NTIS (US Sales Only); INIS		DE93610322	
92/18	18:6911	OSTI; NTIS (US Sales Only); INIS		DE93609934	
92/19	18:7248	OSTI; NTIS (US Sales Only); INIS		DE93610264	
92/20	18:6884	OSTI; NTIS (US Sales Only); INIS		DE93609888	
92/23	18:5994	OSTI; NTIS (US Sales Only); INIS		DE93608934	
92/29	18:7028	OSTI; NTIS (US Sales Only); INIS		DE93610120	
92/30	18:6084	OSTI; NTIS (US Sales Only); INIS		DE93609052	
92/33	18:6085	OSTI; NTIS (US Sales Only); INIS		DE93609038	
92/34	18:5995	OSTI; NTIS (US Sales Only); INIS		DE93608938	
92/41	18:6960	OSTI; NTIS (US Sales Only); INIS		DE93609989	
92/42	18:6912	OSTI; NTIS (US Sales Only); INIS		DE93609954	
92/43	18:6814	OSTI; NTIS (US Sales Only); INIS		DE93609845	
92/46	18:6815	OSTI; NTIS (US Sales Only); INIS		DE93609846	
92/54	18:5996	OSTI; NTIS (US Sales Only); INIS		DE93608939	
92/56	18:7029	OSTI; NTIS (US Sales Only); INIS		DE93610064	
92/58	18:6885	OSTI; NTIS (US Sales Only); INIS		DE93609881	
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143	18:5659	*See* WHC-SP–0300			
UNICAMP-IMECC-RP–					
24/92	18:6816	OSTI; NTIS (US Sales Only); INIS		DE93609847	
29/92	18:6817	OSTI; NTIS (US Sales Only); INIS		DE93609848	
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UTNL-R–					
0279	18:7433	OSTI; NTIS; INIS		DE93753404	
0280	18:7434	OSTI; NTIS; INIS		DE93753403	
UTRCN-G–					
21	18:7435	OSTI; NTIS; INIS		DE93754373	
UVA–					
527390/MANE93/102	18:7043	*See* DOE/ER/12818–2			
UWFDM–					
880	18:7398	*See* KFK–5051			
VTT-JULK–					
761	18:5890	OSTI; NTIS		DE93752852	
VTT-OPT–					
41	18:4912	OSTI; NTIS		DE93752939	
45	18:4913	OSTI; NTIS; INIS		DE93752849	
46	18:4842	OSTI; NTIS		DE93752940	
VTT-PUB–					
102	18:5834	OSTI; NTIS		DE93752851	
108	18:6251	OSTI; NTIS		DE93752853	
89	18:5806	OSTI; NTIS		DE93752850	
VTT-SYMP–					
129	18:5259	OSTI; NTIS		DE93752846	
VTT-TIED–					
1321	18:5232	OSTI; NTIS		DE93752854	
1332	18:5835	OSTI; NTIS		DE93752855	
1335	18:5675	OSTI; NTIS		DE93752856	
1337	18:5807	OSTI; NTIS		DE93752857	
1338	18:6792	OSTI; NTIS		DE93752858	
1350	18:5671	OSTI; NTIS		DE93752859	
1351	18:7505	OSTI; NTIS		DE93752860	
1354	18:5336	OSTI; NTIS		DE93752927	
1356	18:5808	OSTI; NTIS		DE93752861	
1359	18:5008	OSTI; NTIS		DE93752862	
1361	18:6786	OSTI; NTIS		DE93752863	
1364	18:5009	OSTI; NTIS		DE93752864	
1369	18:4904	OSTI; NTIS		DE93752865	
1373	18:6594	OSTI; NTIS		DE93752924	
1376	18:5836	OSTI; NTIS		DE93752866	
1380	18:5809	OSTI; NTIS		DE93752868	
1383	18:5810	OSTI; NTIS		DE93752867	
1384	18:5811	OSTI; NTIS		DE93752869	
WHC-EP–					
0444	18:5183	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001750	MF-602
0554	18:6595	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003638	MF-902
0588	18:7506	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004490	MF-905
WHC-SA–					
1446	18:5207	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001675	MF-700
1586	18:5598	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE93002249	MF-528
1590	18:5765	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE92040418	MF-528
1606	18:6225	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002243	MF-906
WHC-SD-WM-ES–					
219	18:5173	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93005134	MF-902
WHC-SP–					
0300	18:5659	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001476	MF-700
0708	18:7436	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001664	MF-700
0839	18:5599	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001751	MF-900
0841	18:5174	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001670	MF-902
0850	18:5175	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001677	MF-902
0851	18:5176	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93001669	MF-902
0852	18:5093	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001673	MF-500
WIS-PH–					
92-39	18:6305	OSTI; NTIS (US Sales Only); INIS		DE93609388	
WSRC-MS–					
91-511	18:5177	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002807	MF-704; MF-721
92-026	18:5660	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002689	MF-707
92-028	18:5452	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002690	MF-706
92-152	18:5661	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002811	MF-707
92-163	18:5600	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002157	MF-707
92-175-Rev.1	18:6596	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002695	MF-702

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92-285	18:5601	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002403	MF-706
92-288	18:5663	OSTI; NTIS; GPO Dep.	E 1.99:	DE93001896	MF-707
92-305	18:5203	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93000366	MF-706
WSRC-RP–					
92-239	18:6631	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002806	MF-701
92-461	18:5109	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002254	MF-701
92-703	18:5178	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003706	MF-721
92-756	18:5602	OSTI; NTIS; GPO Dep.	E 1.99:	DE93003381	MF-706
WSRC-TR–					
91-141	18:5603	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003374	MF-706; MF-704
91-503	18:7051	OSTI; NTIS; GPO Dep.	E 1.99:	DE93004295	MF-705; MF-706
92-006	18:5179	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93002812	MF-701; MF-721
92-076	18:5604	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE93003375	MF-705
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4764	18:6086	OSTI; NTIS; GPO Dep.	E 1.99:	DE93002703	MF-703
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DE93609485	IEN–26/91
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